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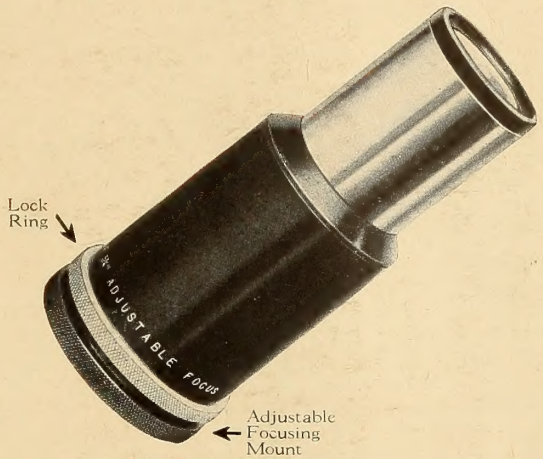
THE MOTION PICTURE
PROJECTIONIST

November 1929

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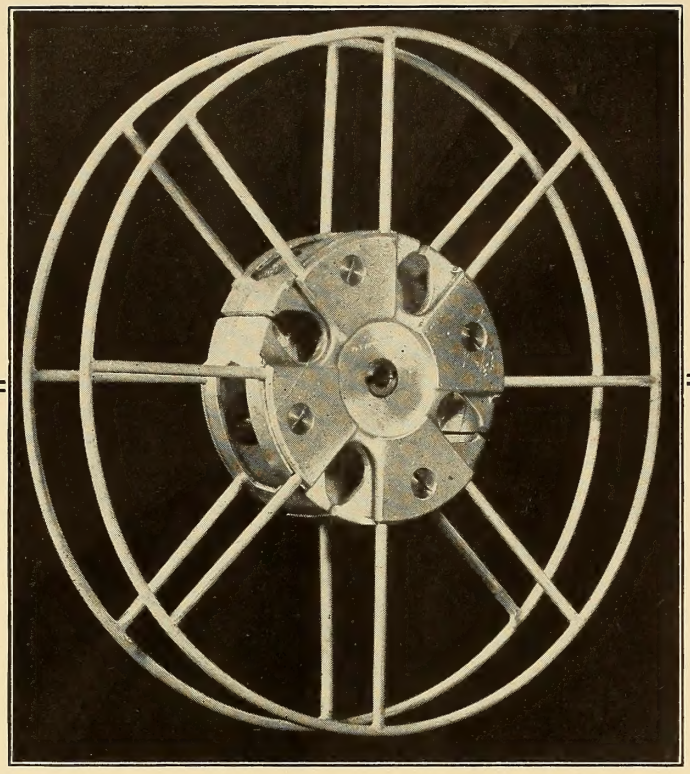
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November, 1929
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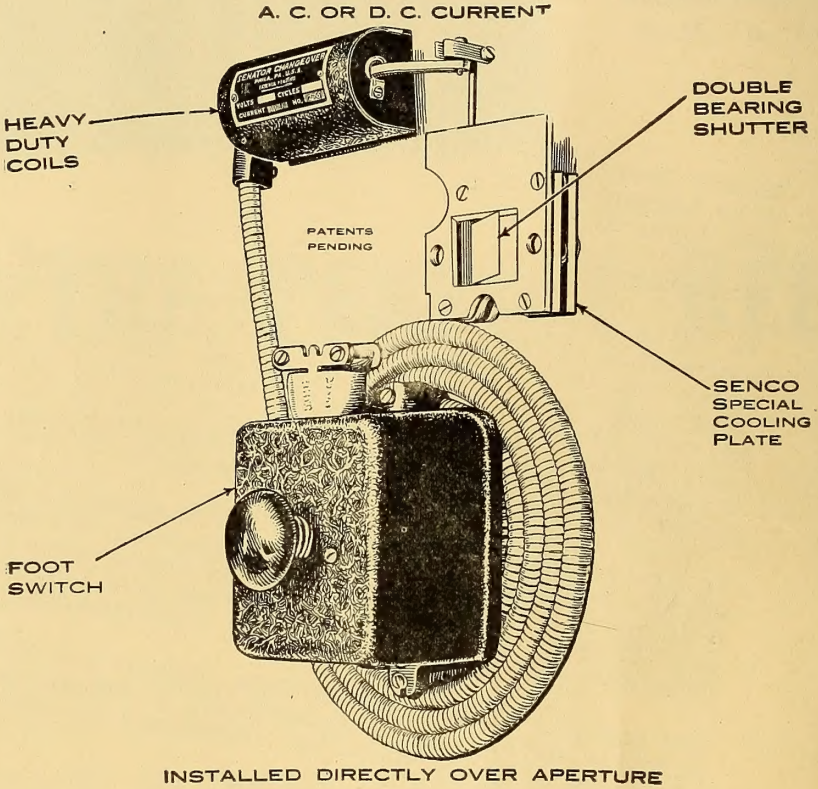
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THE MOTION PICTURE PROJECTIONIST,

published Monthly at New York, N. Y., for October 1, 1929.

STATE OF NEW YORK } ss.
COUNTY OF NEW YORK }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared James J. Finn, who, having been duly sworn according to law, deposes and says that he is the Editor of THE MOTION PICTURE PROJECTIONIST, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Mancall Publishing Corp., 45 West 45th St., New York City; Editor, James J. Finn, 45 West 45th St., New York City; Managing Editor, none; Business Manager, James J. Finn, 45 West 45th St., New York City.

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5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is . . . (This information is required from daily publications only.)

JAMES J. FINN,
Editor.

Sworn to and subscribed before me this 1st day of October, 1929.

NATHAN REIGROD

[Seal] (My commission expires March 30, 1931.)

10,000 Installations by 1930

Production at the big Western Electric factories having speeded up considerably, it will be possible to wire 10,000 theaters by the end of 1930, according to H. M. Wilcox, operating manager for Electrical Research Products, Inc. The latter company now has more than 200 service men stationed at 26 service stations throughout the country.

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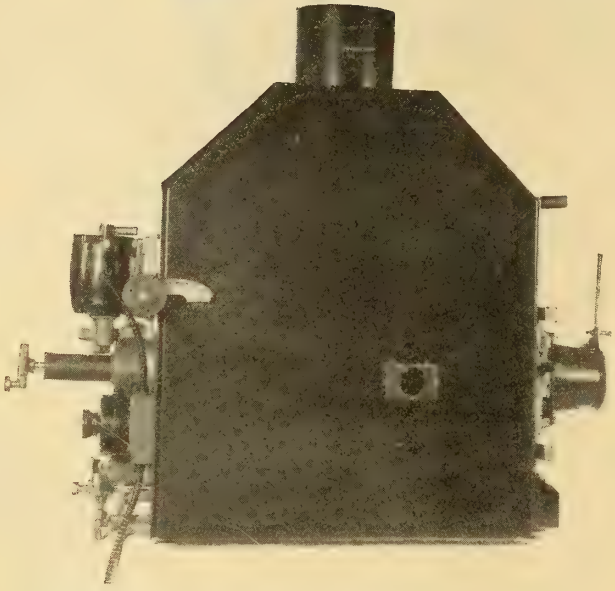
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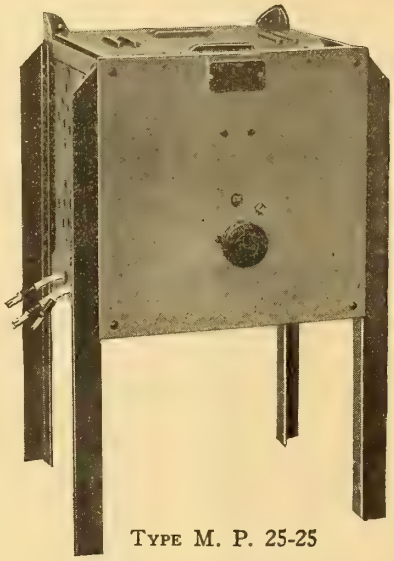
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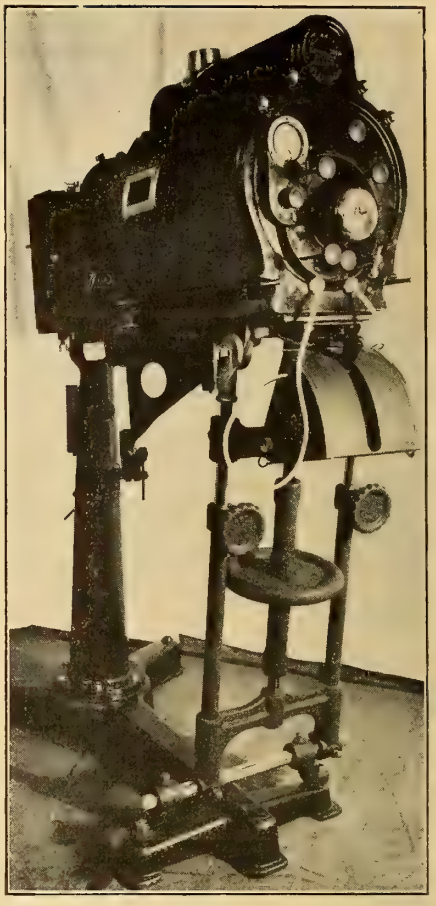
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TO KEEP THE SHOW GOING—



"I may be dumb, but I know when the lights goes out!"

"Say, listen Leona, if you haven't saw Ravoni Bologni in the 'Occasional Bride' down at the Gaiety, you simply **gotta** see that show. It's one of the swellest pitchers I ever seen! That's where I went yesterday, only I started to see it the day before yesterday, like I was going to tell you, but something broke down and they couldn't go on with the show. And mebbe I wasn't **mad!** It was right where things begin to get exciting, if you know what I **mean,** when it broke. Well, mebbe things like that used to happen when grandpa was a flaming youth, but I always say there ain't no excuse for it nowadays, so I walked right out. I should pay to get in and then stay there without seeing anything! And anyway, someone got up and said they was sorry but the show couldn't go on, and wouldn't we get tickets at the door and everything would be all right again next afternoon. **Imagine** anything as crazy as that! So when I got in the lobby there was the fella that runs the joint passing out the rain checks and I walks up to him and says, 'Listen, what do you think this is, 1885 or something? I come here to see a pitcher not to sit in the dark!' 'I am sorry, madam,' he says to me, 'but the accident was unavoidable, accidents will happen sometimes.' 'O, yeh?' I says to him, 'Well, listen, I may be **a home** girl, but I have been around enough to know that moving pitcher shows ought not to bust down like 1901 flivvers!' Oh, did I **lay** him to the daisies! So he says, 'But, madam, you don't understand!' 'Oh, I don't?' I come back at him, 'Well, listen, Wisdom Tooth, I may be **dumb,** but I know when the lights goes out!' With that, I walks out on him cold and only leave him a dirty look to remember me by. But I took the rain check anyhow, dearie, because I always say it's all right to be proud as long as you don't carry it too far. So I went back yesterday and everything was fixed up all right again. And believe me, kid, if it hadn't a been **that** joint wouldn't never have got no more of my shekels!

"But mebbe that isn't a **swell** pitcher!—where Ravoni Bologni—that's her sweetie, see,—comes in and finds her alone with her husband, mebbe he don't DO things! Gosh, I think he's **simply gorgeous,** so listen, kid, you simply gotta see that pitcher!"

THERE are two practical ways of taking out insurance against an interrupted or a completely stopped show: the purchase of good equipment and the use of reliable maintenance service. Today the National Rebuilding and Repair Division is a vital and strongly forged link in the chain of complete theatre service. From coast to coast National Repair Shops are completely equipped to take care of any job—from supplying an emergency mechanism on a moment's notice, to the thorough rebuilding of projector or generator. These shops are staffed by expert machinists and electricians schooled in modern factory methods. Throughout every phase of their craft none but genuine repair parts are used. If overhauling is needed in your booth, don't wait until an emergency! When you get an estimate on the job from your nearest National Branch you'll know why expert maintenance service is one form of insurance you can't afford to be without.

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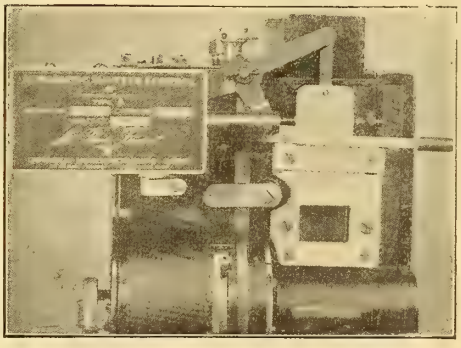
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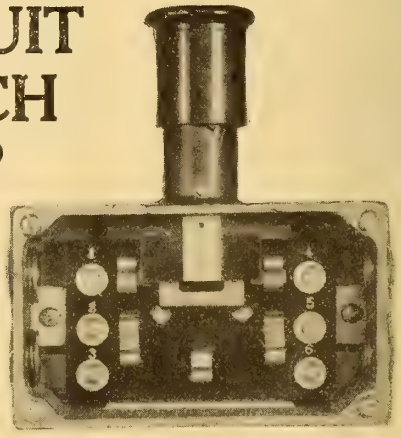
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Storage Battery Standards

THE storage battery is a valuable adjunct of the sound motion picture system. Just now there is a movement afoot among workers in the sound picture field to provide the necessary element which will eliminate the use of storage batteries with sound projection apparatus. Whether these efforts are successful or not remains to be seen, yet the results of this work will take nothing away from the proven dependability of the storage cell nor diminish its effectiveness in those fields in which it has performed long and valuable service.

It cannot be denied that the storage battery has many characteristics which are not to be dimmed by even the best of battery eliminators. Nothing that has thus far been revealed in the development of battery eliminators has indicated that it will match the proven reliability of the storage battery. Certainly the storage battery is noiseless and there is a total absence of line fluctuations. There are other characteristics in its favor too well known to need mention here.

The following listing of "standards" has been adopted as official by the American Institute of Electrical Engineers[1], to whom we are indebted for permission to publish them.

The standards in this section apply to storage batteries of the lead-acid type and of the nickel-iron alkaline type. They are suitable for large and small batteries in either stationary or portable service. These standards conform to accepted usage.

Classification

Storage batteries are classified as stationary or portable batteries on the basis of construction. Stationary batteries are those designed for service in a permanent location. Portable batteries are those designed for convenient transportation during service. Portable batteries may be used for service in a permanent location.

Construction

Storage Battery.—A connected group of two or more electrochemical cells for the generation of electrical energy in which the cells after being discharged may be restored to a charged condition by an electric current flowing in a direction opposite to the flow of current when the battery discharges. Common usage permits this designation to be applied to a single cell used independently.

Storage Cell.—The unit of the battery, consisting of positive and negative plates, separators, electrolyte, and container, for the generation of electrical energy and capable of being recharged by an electric current.

Active Materials.—Materials of plates reacting chemically to produce electrical energy during the discharge. The active materials of storage cells are restored to their original composition, in the charged condition, by oxidation or reduction processes produced by the charging current. In the charged condition the active materials are as follows:—

Plate	Lead Acid Cells	Nickel-iron Alkaline Cells
Positive	Lead peroxide	Oxides of nickel
Negative	Sponge lead	Iron

Grid.—A metallic framework for conducting the electric current and supporting the active material[2].

Positive Plate.—The grid and active material from which the current flows to the external circuit when the battery is discharging.

Negative Plate.—The grid and active material to which the current flows from the external circuit when the battery is discharging.

Electrolyte.—An aqueous solution of sulphuric acid used in lead cells and of certain hydroxides used in nickel-iron alkaline cells. The concentration of the solutions varies somewhat with the type of cell, its use, and condition. The electrolyte of charged cells at 70 deg. Fahr. (21 deg. Cent.), will ordinarily fall within the following nominal limits of specific gravity:—

	Lead Acid Cells	Nickel-iron Alkaline Cells
Maximum	1.300	1.230
Minimum	1.200	1.160

Separator.—A device for preventing metallic contact between the plates of opposite polarity within the cell.

Group.—Assembly of a set of plates of the same polarity for one cell.

Element.—The positive and negative groups with separators assembled for a cell.

Couple.—The element of a cell containing two plates, one positive and one negative. This term is also applied to a positive and negative plate connected together as one unit for installation in adjacent cells.

Jar.—The container for the element and electrolyte of a cell. Specifically a jar for lead-acid cells is usually of hard rubber composition or of glass; but for nickel-iron alkaline cells it is a nickel-plated steel container frequently referred to as a "can."

Tank.—A lead container, supported by wood, for the element and electrolyte of a cell. This is restricted to some relatively large types of cells.

Case.—A container for several cells. Specificially wood cases are containers for cells in individual jars; rubber or composition cases are provided with compartments for the cells.

Tray.—A support or container for one or more cells.

Terminal Posts.—The points of the cell or battery to which the external circuit is connected.

Cell Connector.—A conductor used for carrying current between adjacent cells.

Counter Electromotive Force Cells.—Cells of practically no capacity used to oppose the line voltage. Frequently called "Counter cells."

End Cells.—The cells of a battery which may be cut in or out of the circuit for the purpose of adjusting the battery voltage.

Pilot Cell.—A selected cell whose temperature, voltage and specific gravity of electrolyte are assumed to indicate the condition of the entire battery.

Capacity

Ampere-Hour Capacity.—The number of ampere-hours which can be delivered by a cell or battery under specified conditions as to temperature, rate of discharge and final voltage.

Watt-Hour Capacity.—The number of watt-hours which can be delivered by a cell or battery under specified conditions as to temperature, rate of discharge and final voltage.

Time-Rate.—The rate in amperes at which a battery will be fully discharged in a specified time, under specified conditions of temperature and final voltage. Example, the eight-hour rate or the twenty-minute rate.

Voltage

Open-Circuit Voltage.—The voltage of a cell or battery at its terminals when no current is flowing. For the purpose of measurement, the small current required for the operation of a voltmeter is usually negligible.

Closed-Circuit Voltage.—The voltage at the terminals of a cell or battery when current is flowing.

Average Voltage.—The average value of the voltage during the period of charge or discharge. It is conveniently obtained from the time integral of the voltage curve.

Initial Voltage.—The voltage of a cell or battery at the beginning of a charge or discharge. It is usually taken after the current has been flowing for a sufficient period of time for the rate of change of voltage to become practically constant.

Final Voltage.—The prescribed voltage upon reaching which the discharge is considered complete. The final voltage is usually chosen so that the useful capacity of the cell is realized. Final voltages vary with the type of battery, the rate of the discharge, temperature, and the service in which the battery is used.

Polarity.—An electrical condition determining the direction in which current tends to flow. By common usage the discharge current is said to flow from the positive or peroxide plate through the external circuit. In a nickel-iron alkaline battery the positive plate is that containing nickel peroxide.

Polarization.—The change in voltage at the terminals of a storage cell, when a specified current is flowing, equal to the difference between the actual and the equili-

[1] February 16, 1928.

[2] In certain types of batteries the active material is enclosed in containers which are held in place by the grid.

brium (constant open-circuit condition) potentials of the plates, exclusive of the $I\ R$ drop.

Charging and Discharging

Charge.—The conversion of electrical energy into chemical energy within the cell or battery. This consists of the restoration of the active materials by passing a unidirectional current through the cell or battery in the opposite direction to that of the discharge. A cell or battery which is said to be "charged" is understood to be fully charged.

Charging Rate.—The current expressed in amperes at which a battery is charged.

Constant-Current Charge.—A charge in which the current is maintained at constant value. For some types of lead batteries this may involve two rates called the starting and the finishing rates.

Constant Voltage Charge.—A charge in which the voltage at the terminals of the battery is held at a constant value. A modified constant voltage system is usually one in which the voltage of the charging circuit is held substantially constant, but a fixed resistance is inserted in the battery circuit producing a rising voltage characteristic at the battery terminals as the charge progresses. This term is also applied to other methods for producing automatically a similar characteristic.

Boost Charge.—A partial charge, usually at a high rate for a short period.

Equalizing Charge.—An extended charge given to a battery to insure the complete restoration of the active materials in all the plates of all the cells.

Watt-hour Efficiency.—(Energy efficiency).—The ratio of the watt-hours output to the watt-hours of the recharge.

Temperature

Reference Temperature.—The capacity obtained from a storage battery on discharge varies with the temperature of the electrolyte. The following standard reference temperatures are established.

(1) The temperature of electrolyte at beginning of discharge shall be 25 deg. cent. (77 deg. fahr.). No limit is placed on the temperature attained by the electrolyte during discharge.

(2) The ambient temperature on discharge shall be from 5 deg. cent. to 8 deg. cent. lower than the temperature of the electrolyte, on the beginning of discharge. The ambient temperature shall be kept constant throughout the discharge.

Temperature Coefficient of Voltage.—The change in open-circuit voltage per degree (cent.) change in temperature.[3]

Temperature Coefficient of Capacity.—The change in delivered capacity expressed as a percentage of the ampere-hour or watt-hour capacity per degree (cent.) change in temperature between specified limits.

Critical Temperature.—The temperature of the electrolyte at which an abrupt change in capacity occurs.

Rating of Batteries

General.—Batteries are usually rated in terms of the number of ampere-hours which they are capable of delivering when fully charged and under specified conditions as to temperature, rate of discharge and final voltage. For different classes of service, different time-rates (See definition of time-rate) are frequently used. For comparing the capacities of batteries of different size but of the same general design, it is customary to use the same time-rate, and a comparison based on the different lengths of time they will discharge at the same rate is not recommended as it is misleading.

Misrating.—A battery which fails to deliver its rated capacity on the third successive measured cycle of charge and discharge under specified current rates, temperature of electrolyte, specific gravity, and final voltage, shall be considered to be improperly rated.

Trickle Charge.—A continuous charge at low rate approximately equal to the internal losses and suitable to maintain the battery in a fully charged condition. This term is also applied to very low rates of charge suitable not only for compensating for internal losses but to restore intermittent discharges of small amount delivered from time to time to the load circuit.

Finishing Rate.—The rate of charge expressed in amperes to which the charging current for some types of lead batteries is reduced near the end of charge to prevent excessive gassing and temperature rise.

Discharge.—The conversion of the chemical energy of the battery into electrical energy.

Reversal—Change in normal polarity of a storage cell.

Local Action or Self-Discharge.—The internal loss of charge which goes on continuously within a cell regardless of connections to an external circuit.

Floating.—A method of operation in which a constant voltage is applied to the battery terminals sufficient to maintain an approximately constant state of charge.

Specific Gravity of Electrolyte.—The electrolyte of lead acid batteries increases in concentration to a fixed maximum value during charge and decreases during discharge. The concentration is usually expressed as the specific gravity of the solution. This variation of specific gravity of the solution affords an approximate indication of the state of charge.

The specific gravity of the electrolyte in nickel-iron alkaline batteries does not change appreciably during charge or discharge and therefore does not indicate the state of charge. The specific gravities, however, are indication of the electrochemical usefulness of the electrolyte.

Gassing.—The evolution of oxygen or hydrogen, or both.

Efficiency

Efficiency.—The ratio of the output of a cell or battery to the input required to restore the initial state of charge under specified conditions of temperature, current rate, and final voltage.

Ampere-Hour Efficiency.—(Electrochemical Efficiency).—The ratio of the ampere-hours output to the ampere-hours of the recharge.

Volt Efficiency.—The ratio of the average voltage during the discharge to the average voltage during the recharge.

[3] This is but a few tenths of a millivolt and must not be confused with the effect of temperature on changes in voltage resulting from polarization and $I\ R$ drop when charging or discharging.

S. M. P. E. Toronto Meeting

THE Fall meeting of the Society of Motion Picture Engineers which was held at the Royal York Hotel in Toronto, Canada, October 7-10 inclusive, was a conspicuous success in many particulars. Members of the Society were most enthusiastic about the recent Convention and the general opinion is that it will be hard to better its sessions. It has been the good fortune of the Society to have had every successful development in motion picture work given an advance showing at its meetings.

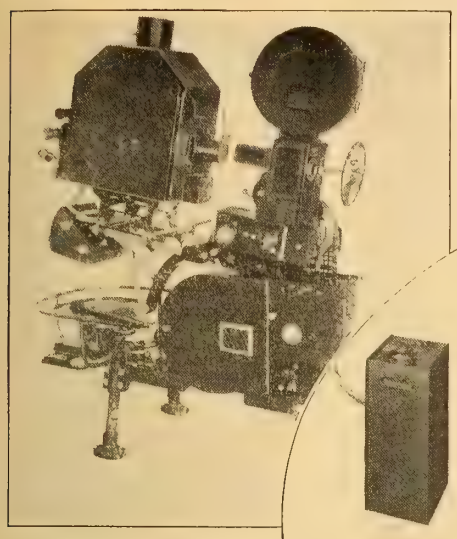
While the papers on sound pictures played a very important part at the Toronto gathering, their contents touched mainly on refinements to existing apparatus and technique rather than in revealing any outstanding new development. For the most part the papers read dealt with highly technical problems of the making and showing of motion pictures.

Many Interesting Papers

Among the papers read which are of particular interest to those interested in projection work were: "The Illusion of Sound and Picture," by John L. Case, RCA Photophone, Inc.; "Theatre Acoustics," by S. K. Wolfe, E. R. P. I.; "The Optics of Motion Picture Projection," by Professor Arthur C. Hardy, Massachusetts Institute of Technology; "The Film Perforation and Means for its Measurement," by W. H. Carson, Agfa Ansco Corp.; "Surface Treatment of Sound Film," by J. I. Crabtree, C. E. Ives, and O. Sandvik; "A New Method of Blocking Out Splices in Sound Film," by Messrs. Crabtree and Ives; "Characteristics of Loudspeakers for Theatre Use," by D. G. Blattner, Bell Telephone Labs.; "Optical Problems of the Wide Film," by Dr. W. Rayton, Bausch & Lomb Optical Co.; "Some Practical Aspects and Recommendations on Wide Film Standards," by A. S. Howell and J. A. Dubray, Bell & Howell Co.; "Some Aspects of Reverberation," by E. W. Kellogg, General Electric Co.; "Water Cooling of Incandescent Lamps," by Dr. N. T. Gordon, General Electric Co.; "Operating Characteristics of High Intensity Arcs," by A. C. Downes and D. B. Joy, National Carbon Co.; and "Camera and Projector Aperture in Relation to Sound Pictures," by Lester Cowan, A. M. P. A. & S.

One subject which seemed to be the general topic of discussion among Society members was the advent of wide film, a development which offers many problems for the engineer. Because wide film has been only recently exhibited, there was not sufficient time for the preparation of papers on the subject before the Society Meeting. However, it is certain that the next Meeting will include many papers on the subject of wide film both in the production and projection fields.

J. I. Crabtree of Eastman Kodak Co., is the new president of the S. M. P. E., succeeding L. C. Porter, Edison Lamp Works.



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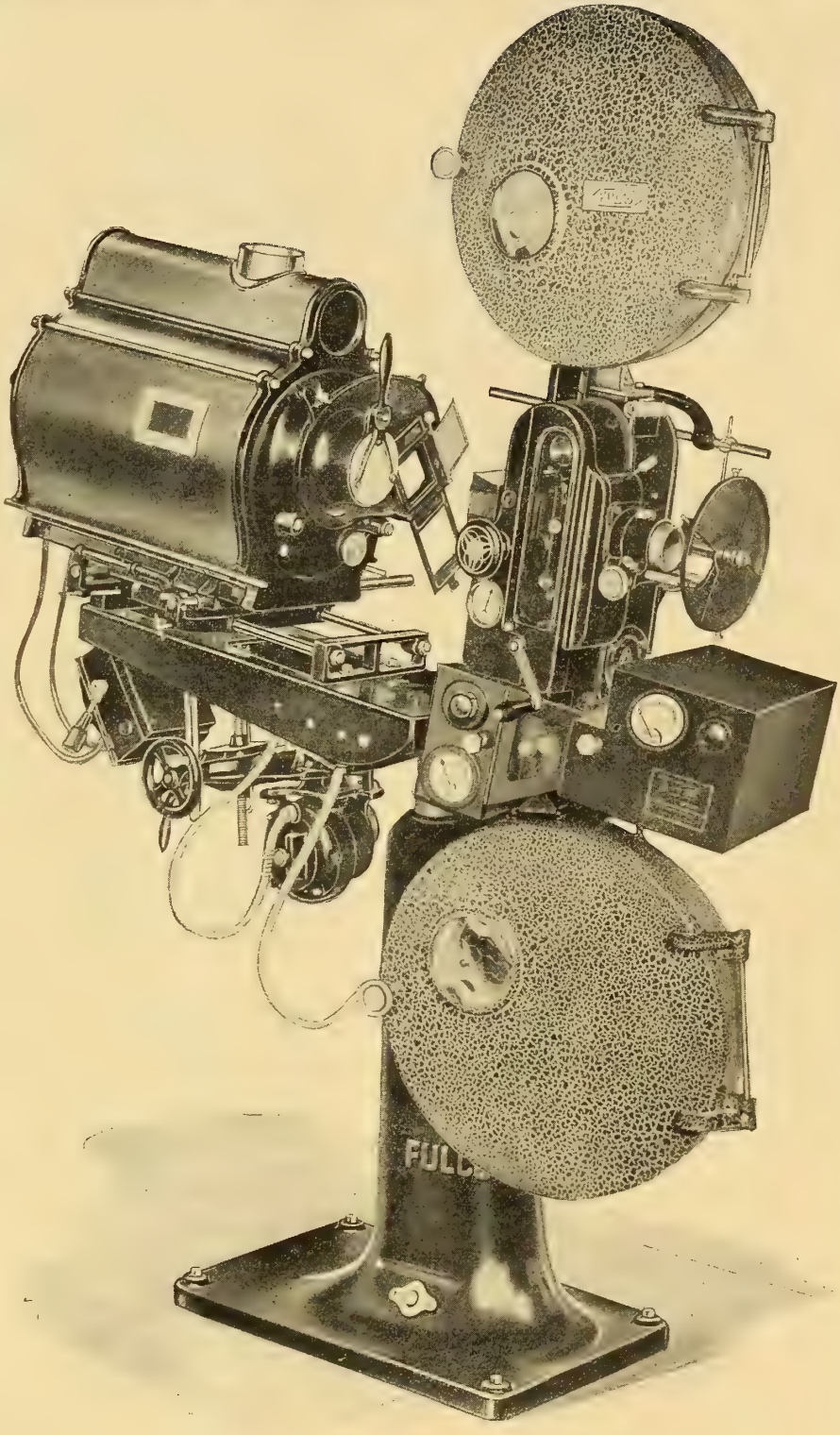
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Waves and Wave Motions

By J. A. DOWIE *Chief Instructor, National Radio Institute, Washington, D. C.*

TO be able to understand how sound waves (speech and music) can be reproduced from a radio receiving set located many miles away from a broadcasting station, a study of wave motion and the characteristics of waves is essential.

A wave may be defined as a disturbance in some elastic substance, the disturbance having a regular period or frequency both as to time between repetitions and as to its strength.

The erroneous impression exists in many minds that it is the medium which actually travels away from the point where the disturbance causing the wave is created, but it should be clearly understood that the medium as a whole remains stationary, and the wave action of the individual particles is purely local.

For example: If we lift one end of a straight rope and shake it briskly up and down, a wave is thus started in the rope which will travel down its length. It is evident that in this case the wave consists of a successive and individual vertical motion of each point of the rope. If the rope is shaken twice, two waves will be started which travel away to the other end, keeping always the same distance apart. If the shaking of the rope is repeated rhythmically, a continuous wave motion is started which transmits the energy imparted by the hand to the other end of the rope.

Analysis of Waves

The high points of a wave are called the crests, and the low ones troughs. The distance between two successive crests is the wavelength, the height of the crest above the trough, the amplitude, while the speed at which the wave apparently travels is called the frequency. The frequency is expressed by the number of waves passing a given point each and every second. The above terms, "wavelength," "amplitude," are graphically illustrated in Figure 2 and it is well to bear their relationship clearly in mind.

Science has gradually realized that all of the perceptions of our senses are due to waves generated in a substance which seems to permeate everything, and which has been called the ether. That such a substance actually exists has long been doubted, but the study of the phenomena in connection with the transmission of heat, light and electricity shows that they are all due to wave action which cannot be explained unless by the assumption of a medium for these waves to travel in.

All ether waves travel with the same velocity of 300,000,000 meters per second, which is equivalent to about 186,500 miles. They differ widely in their wavelength, however, and are known to range from a wavelength of 150,000 meters which are the longest radio waves yet encountered, to a wavelength of 500 billionths of a meter. All these waves are apparently identical in nature.

Some of them can be discovered only by the most delicate instruments, some of them by the sensations of what we know as heat and light; and in the latter case, the different colors are again differentiated by wavelength variation. Some penetrate so-called opaque objects, and are known to act as X-rays; some are invisible to our eyes and to our senses, yet produce certain pathological effects upon the body such as sun-stroke, and it has been claimed



Figure 1

softening of the bones, and finally, some can be detected only by radio apparatus.

Sound Waves

Sound is a wave motion of the air, not of the ether. If a bell or a piano wire be struck, the bell or the wire will vibrate many hundreds or even thousands of times per second. Every vibration hits the sound in the air a slight blow which starts a wave in the same manner as in the experiment with the rope. From the source of the vibration, these sound waves travel outward in every direction, gradually becoming weaker as the distance from the source increases.

In the delicate mechanism of the human ear, the vibrations impinge against the eardrums and cause them to vibrate at the same speed, thus producing what we know as sound. The greater the amplitude of the original vibration, the further will the wave be transmitted; hence, the amplitude

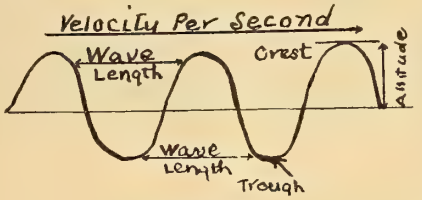


Figure 2

of a sound wave corresponds to the loudness of a tone. What is known as the pitch, on the other hand, is a result of the number of vibrations per second or frequency.

The lowest tones which the human ear can hear and distinguish correspond to about 30 vibrations per second, the highest to about 18,000 vibrations per second. Anything above or below these values are audible not as a musical note but as a noise.

A vibrating source producing a single frequency is said to produce a pure tone. The frequency of the source is referred to as the pitch. Musical tones, however, as produced by bowing a violin or striking a piano, do not consist of pure tones but ordinarily consist of a particular frequency and in addition a number of other frequencies, known as harmonics. Harmonics are frequencies which are multiples of a given frequency known as the fundamental. Thus, if we strike a piano note, the fundamental frequency of which is 500 cycles, we would also find present in the air sound waves having frequencies of 1,000, 1,500, 2,000, 2,500, 3,000, 3,500, etc., cycles.

In radio work, we like to refer to the frequency having a value twice that of the fundamental as the second harmonic, the frequency having a value three times the fundamental as the third harmonic, and so on. While the pitch of a musical tone is determined by the frequency of the fundamental, the tone quality or timbre, as it is sometimes called, depends upon the ratio of the amount of energy in the various harmonics to that in the fundamental. It is this ratio which enables you to determine, even though you may not be able to see the instrument, whether or not the tone is produced by a piano, violin or singer.

The ordinary land telephone affords the means of reproducing sound waves at a distance far greater than the original wave will cover. The sound wave strikes a metal diaphragm which is thereby set in vibration. To the diaphragm is attached an electrical contact composed of small pieces of carbon rather loosely held together, through which a current is flowing. When the carbon particles are compressed by the motion of the diaghragm the resistance of the particles is decreased because they are brought in closer contact with each other, and a greater amount of current flows in the circuit.

Transmitting Apparatus

This current is then made to pass through an electromagnet at the other end of the line and the magnetic charge in the magnet will vary in accordance with the current changes. The magnet acts upon the other diaphragm at the receiving end which vibrates in synchronism with the transmitting diaphragm and generates sound waves corresponding to the original one.

The apparatus used to send forth through space the electromagnetic waves which carry speech or musical vibration in any broadcasting system consists of three essential parts. The first of these is a radio frequency generator which produces uninterrupted constant-amplitude alternating current of exceedingly high frequency. The second is a modulator, which controls the amplitude of this high frequency alternating current and varies it in strict accordance with the sound vibrations to be transmitted. The third is the radiator, or antenna system, which will aid in converting the sound modulated radio frequency current impressed upon it into corresponding electromagnetic waves in the ether or space.

Coast Technicians Strive for Standard Aperture Size

HOLLYWOOD motion picture studios are now composing all vital elements in sound-on-film pictures within an area of 0.620 by 0.835 inches altho continuing to photograph the whole frame. This is in accordance with specifications recently recommended by the Academy of Motion Picture Arts and Sciences, Technicians' Branch, acting jointly with the Technical Bureau of the Association of Motion Picture Producers, the American Society of Cinematographers, the Pacific Coast Section of the Society of Motion Picture Engineers and the California Chapter of the American Projection Society.

Theatres which restore the full screen image from sound-on-film pictures have been notified that to secure the maximum image size in 3 by 4 proportion they should use projector apertures whose size would be 0.600 by 0.800 inches on the basis of projection on the level, the horizontal center of the aperture coinciding with the horizontal center of the S. M. P. E. standard aperture.

Nationwide Survey

The recommendations and action by the studios followed the revelation through a nationwide survey that theatres are using a wide variety of aperture sizes in projecting sound-on-film pictures. It was also found that an increasing number of theatres are restoring the full screen proportion through the use of a smaller aperture, lenses of one-half inch shorter focal length, and various re-centering devices. As only two studios were composing to allow for this, the result was that in many theatres part of the heads and feet of characters were cut off in projection. The recommendations of the technical societies are designed to correct this serious condition and were chosen as the best means of the projector aperture sizes among a number of large theatre chains.

Studios which are now marking the ground glasses of their cameras to conform to the recommended practice are: Paramount-Famous-Lasky, Metro-Goldwyn-Mayer, United Artists, Pathe, Universal, R. K. O., Tiffany-Stahl, Mack Sennett, Darmour, and Educational. The Fox Studio markings are the same width but allow .04 inches more height.

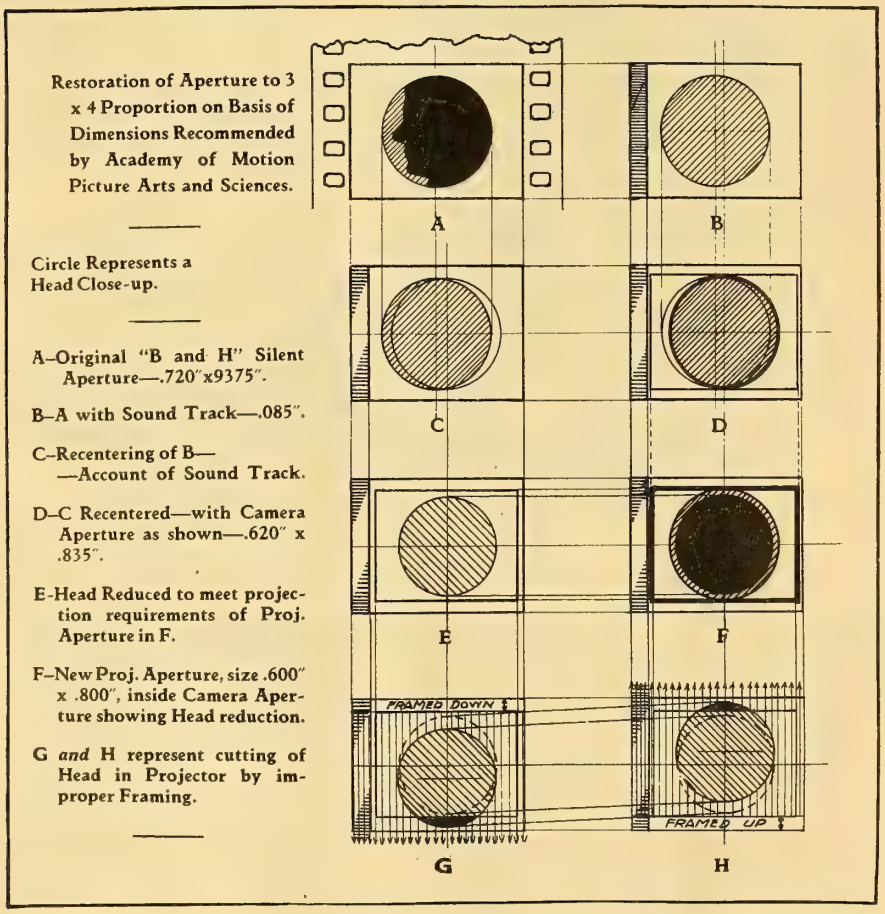
Committees representing the motion picture technical organizations in Hollywood are also studying the problems of standard release print practice and screen illumination under the sponsorship of the Academy.

Projectionists Aid

In addition to the participation of the Los Angeles chapter of the American Projection Society as an organization in sending out questionnaires, discussing the proposition and endorsing the final recommendations, a number of projectionists were active personally. Sidney Burton, president of the Los Angeles A. P. S. chapter, E. W. Anderson and Albert Feinstein were members of the joint committee from the different organizations which drew up the resolution. David Koskoff, as secretary of the A. P. S. chapter, also gave much help in collecting data on projection conditions in theatres throughout the United States and Canada.

325,000 Engaged in Pictures

More than 325,000 persons in the United States secure their wages from pictures, according to a recent estimate. More than 100,000,000 persons attend picture shows weekly, it is declared, with the 20-odd thousand theatres of the United States said to have an aggregate seating capacity in excess of 18,000,000. The 100,000,000 figure, it is said, represents about a 100 per cent increase over attendance of a few years ago.



By V. E. Miller, *Paramount-Famous-Lasky*

Suggests 51 mm. As the Ideal Film Size

THE sound track has encroached upon the picture area to a very awkward extent. The Movietone frame and the 70 m.m. Grandeur film are two unhappy extremes. This wide picture seems to claim favor as an approach to the visual range of the eye. We believe this is a mistaken promise. Let us not forget that the great range of the human vision is provided us as a means of protection, but that the choice field of vision is very limited.

Effect on the Eyes

A simple experiment will demonstrate that when we select a prospect, the area of critical interest is very narrow, and beyond this, is merely a conscious retinal periphery. All forms of pictorial art demand a narrow, but pleasing, projection, and we venture that there is little artistic appeal in an excessively wide film. We should carefully distinguish between a larger picture, in the taking, and a wider screen.

A larger initial picture may certainly have many advantages, provided there are no mechanical difficulties in the projection. Its value may be understood by an exaggerated comparison—if we imagine a motion picture, of the dimension of a lantern slide, projected to the size of the standard screen, we would have a picture of incomparable beauty and smoothness of grain, and all other blemishes would be proportionately reduced.

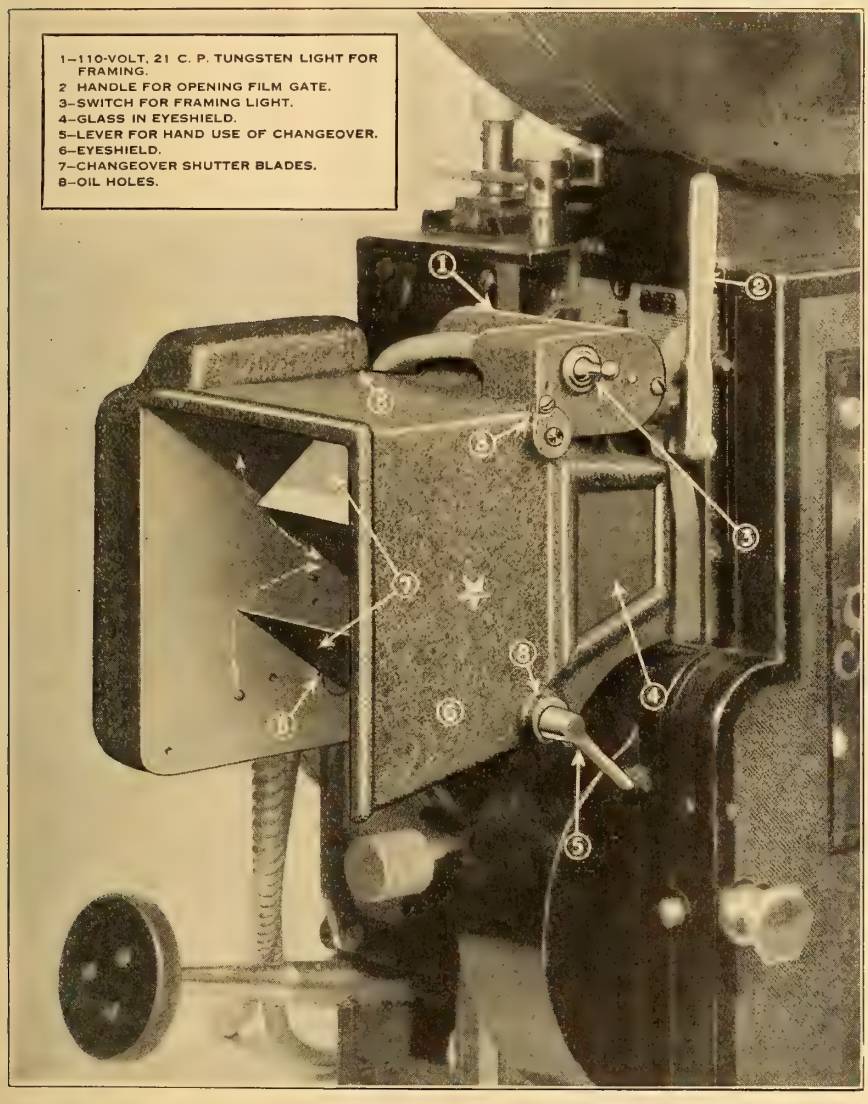
51 mm. Standard

It is logical to assume that the picture must, eventually, be provided with a space for the sound track; this could be done in the positive only without disturbing the standard proportions of the negative. If the industry insists, however, on a change, the ideal dimension appears to be that suggested by Westerberg, 51 m.m. wide, with the picture 36 m.m. x 22½ m.m.

It is terrifying to contemplate scrapping the present standard equipment, but anything so revolutionary as the "talkies" demands equally radical changes in the machinery to produce them artistically.—LEWIS W. PHYSIOC in *The International Photographer.*

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Television—Present and Future

By THOMAS W. BENSON

TELEVISION will develop along two rather well-defined lines. We now have operating on regular schedule several radio stations that are transmitting pictures experimentally which may be received by those properly equipped to do so. These pictures are crude, admittedly, are too small and lack detail to the point where they have but meager entertainment value. What of it? The radio spark transmitters of fifteen years ago also lacked entertainment value in exactly the same sense, yet the results obtained by these crude amateur experiments provided the nucleus for much subsequent serious work.

Present results attained with television apparatus evoke much criticism, which is usually couched in the general statement that television will not be here for five, ten, or twenty years. The most important objections raised are that there are too many mechanical difficulties to be overcome, no channels to carry the signals, the equipment is too expensive, etc., and the rather disheartening circumstance about these attacks is that those who have faith in the future of television must admit them to be well-founded—that is, when applied to television for individual home use.

Television in the Theatre

However, I do not believe that the real television will come first to the home for the reception of pictures by radio nor as an attachment to the telephone—another long sought-for ideal. It is my opinion that the expense attached to television equipment will be prohibitive for the bulk of home-owners. Those firms in the front rank of television development are inclined to the belief that television will first be introduced as a form of entertainment within the theatre.

In this way we can see the possibility of installing equipment which would be entirely beyond the financial means of the individual in the theatre where performances would go on on schedule just as the motion picture is exhibited today. The present-day motion picture theatre will be tomorrow's television theatre. In this fashion will television be introduced, and the expenditure of from thirty to forty thousand dollars will not be unreasonable if results comparable with motion picture results of today are attained.

We might compare this line of development with that of the radiophone. With the perfection of the radiophone transmitter, it was thought that everyone would soon carry a small portable set and would telephone anywhere, anytime by radio. This has not come to pass, yet the individual can pick up his or her telephone and "go on the air" from a central transmitter or can go personally to one of the radio broadcasting stations. And so in television. The individual may not own a television receiver but he will be able to enjoy a television performance at his neighborhood movie house at a nominal charge.

Sources of Material

It is obvious that the large television receiver must receive pictures from two sources. We have the usual entertainment source, namely, filmed stories. It is likely that the earliest transmissions will be from films for reasons which will shortly be explained. The second source is the picturing of events the instant they occur, which, by the way, is true television. The latter method is, of course, exceedingly difficult with the apparatus now available, although it has been accomplished under laboratory conditions.

To the eye a picture has two dimensions—height and width—and consists of numerous shades of light and dark. The present means of electrical communication will transmit only one dimension—that is, they will transmit only such matter as can be re-created by variations in the current flowing over the channel of communication. The problem of television, then, resolves itself into reducing the two-dimensional picture to one dimension and transmitting the changes in tone of the picture. The usual practice is to reduce the picture to one having all width and no height, that is, practically speaking.

Equipment Used

This sounds impossible; but if we were to consider a picture cut into a number of strips crosswise and then these strips all joined end to end, we would have the same highlights and shadows as were in the original picture, yet we would have reduced the picture to one dimension—that of width. It would not resemble in the least a picture; but we can transmit the variations in shade along this strip and at the receiving end arrange to cut the strip into lengths and, by arranging them one above the other, rebuild the picture.

It all may seem like magic, and although we do not actually cut the picture up, the effect is the same, as the action must be carried out at least 16 times a second in order to get even fair results. Speeds of 20 per second will doubtless be used.

Let us consider slitting up a film for transmission. This process is known as scanning and is shown in Figure 1. The film to be transmitted is projected to any desired size—let us say one foot square—by means of a regular projector. A cooling system on this projector is advisable so that the film may not become hot and buckle. The film moves smoothly instead of intermittently as in a standard motion picture projector.

Back of the aperture through which the picture is projected is mounted a disc that has holes drilled through it in a circle near the edge. These holes should be square and are as large as the strip desired is wide, and are separated, the distance equal to the width of the projected picture. Behind the disk is mounted a photo electric cell of the alkali metal type, the properties and operation of which have been described at length by Samuel Wein in these columns.[1] Little more about these cells need be said here except that the current flowing through the cell will vary in direct proportion to the amount of light to which it is subjected.

16 to 20 Scenes a Second

Now let us start the transmitter. The light from the arc in the lamphouse throws the picture on the disc. The disc is started revolving, and as the first hole sweeps across the top of the picture, the varying lights and shadows across the strip fall upon the photo electric cell and are translated by the cell into varying electric currents. Now the film moves slightly and the next hole in the disc travels across a strip just below the first strip, and the lights and shadows thereon are reduced to equivalent electric currents. Again the film

[1] August, September, October, December issues, 1928; January, April, July, September, October, 1929.

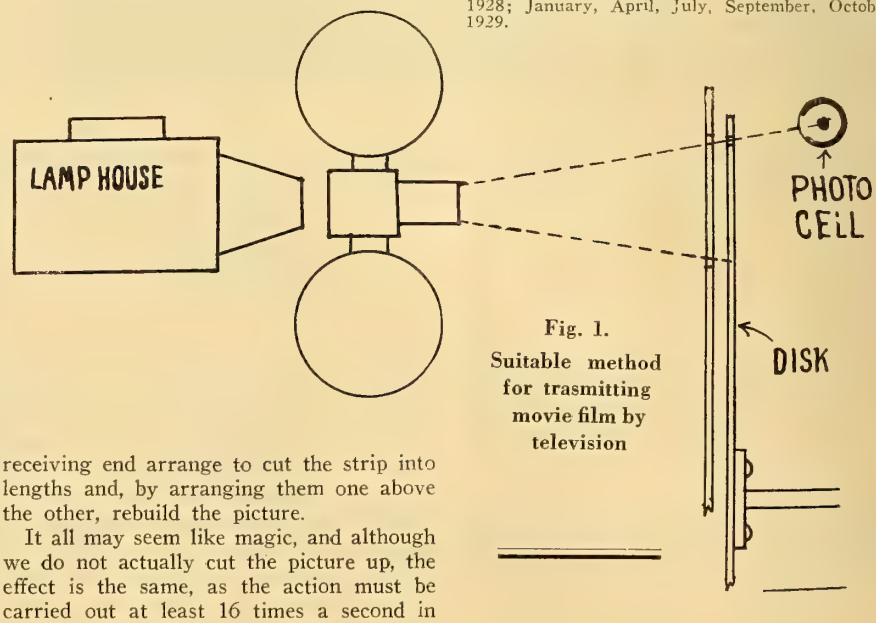


Fig. 1. Suitable method for trasmitting movie film by television

is moved and the third hole covers the third strip in exactly the same manner. This action continues until the whole picture is viewed.

Transmit Sound and Scene

In practice, this action is speeded up until from 16 to 20 scenes are covered in a second. Thus it is seen that the "eye" of the television apparatus (the photo electric cell) sees the scene only as a long strip and transmits it as such.

It is fairly clear that the film, if it carries a sound track, could be run through a sound head and the sound transmitted as well as the scene. This would give us ideal television.

Scanning the Image

Let us consider for a moment how the scanning of an actual scene is accomplished, for here it is obvious that we cannot move the subject being transmitted as in the case of movie film. The system that will be used for such purposes is illustrated in Figure 2 which shows an object illuminated by arcs while a lens reduces the scene to the size of a scanning aperture before the disk. Behind the disk is the photo electric cell that picks up the varying light densities of the scene.

However, it will be noted that the disk in this case has the holes drilled spirally. Thus, as it is rotated, the outermost hole covers the top strip of the picture, the next hole being nearer the center scans the next strip, and so on till the whole scene is covered or viewed. Here also the action must be speeded up to the minimum of 16 per second.

Types of Disks Used

Note particularly the difficulties introduced. With the film transmitter, the holes in a line permitted the use of any size disk found desirable, for the disk could be speeded up so that as many holes as necessary could pass over each scene. That is, if we desired the scene slit into one hundred strips, the film was moved one hundredth of its height between the passing of each hole, and the disk was run fast enough to get one hundred holes past for each scene.

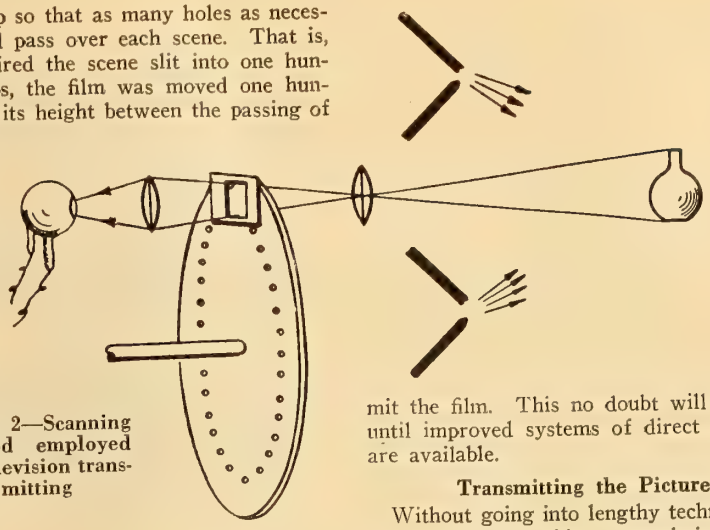


Fig. 2—Scanning method employed for television transmitting

With the spiral disk this condition does not hold. We can only determine the number of strips the picture is divided into by the number of holes, and the disk revolves but once to scan a scene. Suppose we wish to cut the scene into 100 strips:—this would mean that 100 holes would have to be drilled in the disk, and with a small picture—say, only two inches square—these holes would have to be two inches apart. Thus, a disk some 200 inches in circumference would be required, or more than 5 feet in diameter.

Were we to increase our requirements to a picture similar to the one discussed with film transmission, we would need a disk some 35 feet in diameter. This method of transmission is, then, far from perfect, but a possible solution is to photograph the events with a movie camera and then transmit the film. This no doubt will be done until improved systems of direct scanning are available.

Transmitting the Picture

Without going into lengthy technicalities, we will now consider transmission of the picture. This deals with the frequency of the currents necessary to transmit the picture. It will be readily understood that the light coming through the hole in the scanning disk at any instant is the sum of the light values of that portion of the scene being viewed, and any small detail in that area will be identified only as it affects the total light from that area. Hence, it can be said that the total area exposed at any given instant comprises a picture unit, and only details as large as picture units will be transmitted. Since each change of light gives a change in current, and the scanning disk recognizes areas as large as the hole, the maximum number of changes of light possible would occur where each succeeding picture unit was black and white. From this it can be shown that the maximum frequency to be transmitted is equal to half the number of picture units; and the minimum will be equal approximately to the scanning rate, or 16 to 20 scenes a second.

We will find, then, that should we desire to split the film being projected into strips that will give us good detail, we will require at least 80 strips to the inch of the enlarged picture, resulting in 6,400 picture elements per square inch, or more than 9 million for the whole picture.

Current Requirements

With each scene being transmitted in 1/20th of a second, it can be shown that a current frequency of 9 million cycles per second would be required to successfully transmit the picture. However, this may not appear entirely impossible when we consider that by selecting proper backgrounds, shooting scenes differently and limiting the number of actors, we can eliminate much of this need for detail; and it is the writer's belief that the frequency actually required need not exceed 2 million cycles.

This figure presents communication engineers with a very difficult problem, for most wire channels are taxed at 20,000 cycles and require correction. While short wave radio channels might handle the necessary frequency at the extremely short waves, they are unreliable for the purpose.

It is necessary that some method be developed to handle these frequencies, and it

(*Continued on page 34*)

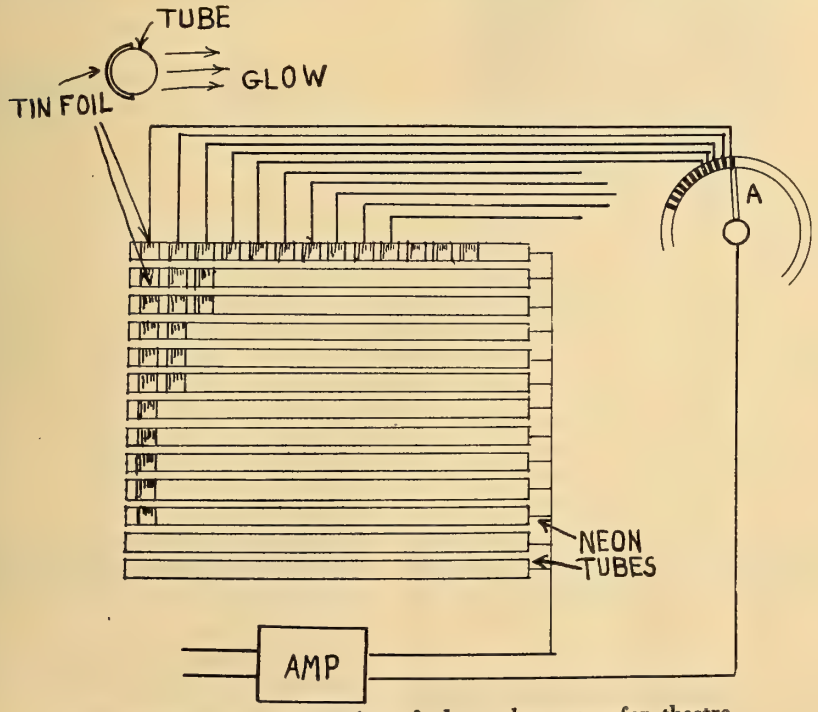


Fig. 3—Principle of operation of glow tube screen for theatre showing of television

Carbon: Its Properties and Uses in Motion Picture Projection

BY ENGINEERING DEPT., NATIONAL CARBON CO.

III

THE motion picture projector is a very reliable piece of mechanism. Although subjected in some instances to intense heat, it will, if properly taken care of, last a long time and give excellent service. All parts of the machine should be kept clean and well oiled. Connections should be kept tight, carbon jaws cleaned regularly to prevent corroding, condensers cleaned daily, and, not least of all, the proper sizes and grades of projector carbons should be used.

It has been our experience that a very large percentage of complaints registered have not been due to the quality of the carbons, but, rather, to operating conditions, or to the fact that wrong carbons were being burned. Perhaps some space devoted to operating precautions will be of value. Let us take the old type of low intensity lamps first.

D. C. Low Intensity Lamps

These lamps are generally known as the old-type lamps. The usual complaints received on carbons used in these lamps are: (1) Arc traveling or wandering (2) Burned-out or burned-back craters (recessing) (3) Lip on the upper carbon (4) Mushroom points, i. e., a button formed on the negative (5) Excessive spindling, and (6) Sputtering at the arc. Let us take up these points in the order given.

Arc Traveling or Wandering

We will confine ourselves for the time being to machines operated on direct current. As has already been stated, before the advent of Silvertips, the common practice was to use a large diameter regular cored or solid projector carbon in the lower holder. This negative carbon in most cases was slightly smaller in diameter than the positive; although in others, the same diameter was used. With the large blunt point on the negative it was not possible to keep the arc steady and in one spot. It wandered all around the point. (See Fig. 18 showing ¾" cored upper and ⅝" cored lower).

This resulted in poor light on the screen. Then, too, the large negative carbon in some instances masked or obstructed some of the light from the positive crater and this naturally decreased the illumination. Obviously the thing to do was to use a negative of smaller diameter. A plain carbon would not carry the current, so metal was applied to produce the carbon now known as Silvertip.

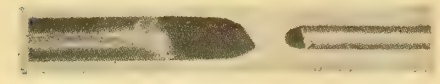


Figure 20



Figure 21

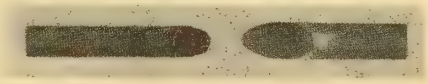


Figure 18

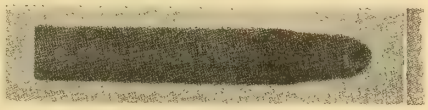
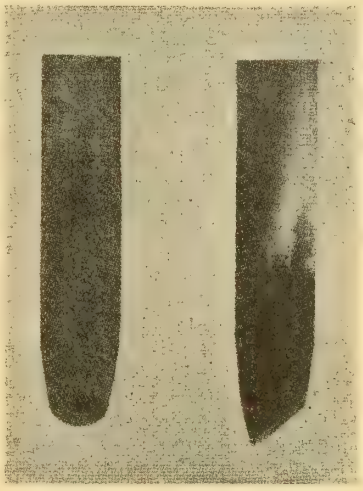


Figure 19

Burn-out or Burn-back Craters

Usually this condition is caused by either one of or a combination of three things: (1) too high a current (2) too low a current and/or (3) the use of carbons too large in diameter. If the current is too high, the force may blow the core out. (Fig. 19.) If too low, or if the wrong combination is being used—such as ¾ x 12" cored upper and a ⅝" cored lower at an arc amperage of, say, 35—the current is so low that the soft core material is consumed more rapidly than the surrounding shell and the result is a very deep or recessed crater in the positive carbon. Under such conditions, the core in the negative carbon will invariably burn back. (Fig. 18).



Left: Fig. 22; Right: 22A

In the first mentioned case, the remedy is to cut the current down to the proper amount; and in the second and third cases to increase the current to the proper amount. Damp carbons will also cause the core to burn back or recess.

Lip on Upper Carbon

This condition is caused by an improper setting of the carbons. The negative carbon has been set too far forward (Fig. 21). Figure 22 shows the blunt point obtained when the negative carbon is set too far back. Obviously most of the light will be thrown downward rather than forward through the condensing lenses. Figure 22A shows good crater formation.

Mushroom Points

If too short an arc is drawn, a "button" is formed on the tip of the negative carbon (Figs. 23 and 24). This is caused by the deposition of particles of carbon from the positive on to the point of the negative carbon and this phenomenon will happen with any style or make of negative carbon. The condition referred to is commonly spoken of as "freezing of the arc." The proper arc length to draw is about ¼" to ½". When striking the arc, the points should be separated quickly, otherwise you may shatter the positive crater or graphitize both points.

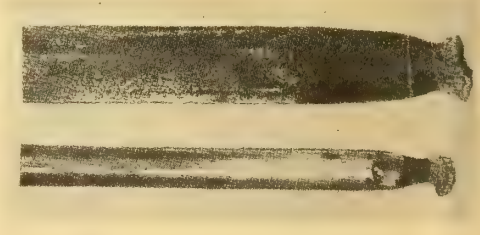
Excessive Spindling

One cause of excessive spindling is that the carbons are being overloaded. Figures 25 and 26 show a ⅝" cored positive carbon overloaded, and a $\frac{5}{16}$" Orotip solid negative carbon overloaded.

Care should be taken that the combinations of carbons which our engineers have worked out and have recommended are used. Spindling may also be caused by poor contact in both positive and negative holders. Both upper and lower jaws or holders should be cleaned out regularly so that the contacts will be smooth.

Sputtering at the Arc

Sputtering at the arc may be caused by carbons not being properly set or trimmed, or by too short an arc; more frequently, though, it is caused by a damp carbon. Carbons are porous and absorb moisture. They are baked at extremely high temperatures in our factory; when they leave the factory they are thoroughly dry. In shipment, however, they may be exposed to damp weather, or at point of destination stored in a damp basement. Carbons should be kept in a dry place. A great many projectionists have formed the habit of laying a few carbons on top of a rheostat in order to expel any moisture that might have been absorbed after leaving the factory. Others put a trim in their lamp-



Top: Fig. 23; Bottom: Fig. 24

houses before burning. Either practice is a good one and is to be recommended as a damp carbon may chip at the crater in addition to causing a sputtering arc.

It might be added here that carbons are not perishable: they will be as good ten years from now as they are today. If they have absorbed water only, they can be dried out in the manner just referred to. However, if a chemical has been spilled on them, they may be rendered worthless, depending on the nature of the chemical.

A. C. Low Intensity Lamps

Of the few carbon complaints made, those which are common to direct current—such as excessive spindling, arc traveling, burned out cores, sputtering, etc.—are likewise common to the alternating current arc, and the remedies previously prescribed will eliminate them. For A. C. work the same diameter is recommended for both upper and lower carbons. In all cases the carbons should be cored. Care should be taken that the upper carbon is set at an angle of approximately 20° from the vertical, while the lower carbon is vertical (Fig. 27).

Unless watched closely, the lower carbon will mask the crater of the upper carbon; consequently the maximum amount of light does not reach the condensers. After every reel the arc should be lengthened, thus permitting the burning off of the lip and making possible the V-shaped crater.

Mirror or Reflector Arc Lamps

AS has already been emphasized, the proper combinations of carbons should always be used. The contacts should be



Figure 25

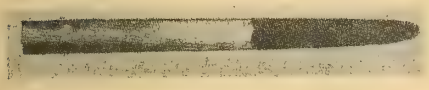


Figure 26

clean. In the horizontal type of mirror arc lamp, i. e., the type in which both positive and negative carbons are set in a horizontal position, with the negative feeding through a hole in the reflector, the negative carbon should be set slightly lower than the positive so that the positive carbon will burn with a "cup-shaped crater" (Fig. 28).

If the negative carbon is set too low, a lip will be formed on the upper edge of the positive carbon and the light will be thrown downward, with a certain percentage of light being lost insofar as its value for screen illumination is concerned (Fig. 29). If the negative carbon is set too high, a lip will be formed on the lower edge of the positive carbon and the light will be thrown upward, with a resultant loss in light on the aperture plate (Fig. 30).

In the angular type of mirror reflecting arc lamp, that is, the type in which the positive carbon is set in a horizontal position and the negative at an angle of about 75° with the horizontal, the negative carbon should be set so that a square or cup-shaped crater is formed. It is taken for granted, of course, that both positive and negative carbons will be in alignment, otherwise some of the light would be deflected to the side of the lamphouse.



Figure 27

Care of Lamps

Figure 31 shows a 12m/m X 8" positive and an 8m/m X 8" negative burned at 40 amperes. Both positive and negative carbons have spindled or needled excessively due to the very heavy overload. It will be recalled that this trim is recommended for 21 to 25 ampere service. The same trim is shown in Figure 32 operated at the specified current load. Excessive spindling, however, is not always due to overload, for it may be caused as readily by lack of sufficient pressure on the carbon in the holder. It may also be caused by the carbons being clamped too far away from the burning points, thus necessitating the carbons carrying the current load their entire lengths.

Of all the projection lamps on the market today the mirror or reflecting arc type is the most sensitive to draughts of air passing through the lamphouse. This is due to the fact that the current employed is considerably less than that used in any of the other types, resulting in the emission of a comparatively weak arc stream. Extreme care should be taken to have the ventilating system on the lamp so regulated that the exhaust fan, when in operation, will not extinguish the arc.

High Intensity Lamps

Short life of high intensity positive projector carbons may result if the positive carbon is set too far forward. As slight

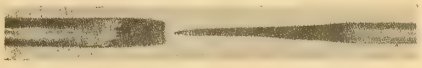


Figure 31

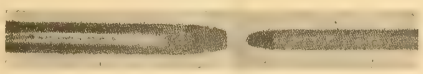


Figure 32

a protrusion as 1/8" beyond the proper point will decrease the life, we have found, about ten per cent.

Corrosion Troubles

Now and then someone complains about the Orotip negative projector carbons spindling in high intensity lamps. In the H & C and Sunlight lamps the V-shaped rest (as it is commonly referred to) carries a certain percentage of the current. In order to function efficiently this rest must be kept perfectly clean so that a good contact is assured. Many projectionists consider it worth while to chip out any corrosion, which might have formed, after every reel. In other cases, this corrosion is allowed to remain until such time as very little current is passing through the V rest, consequently, all of the current is obliged to flow through the lower clamp or holder with the result that the entire carbon is carrying the load. Being of very small diameter, it breaks down under this load and the carbon "spindles" or "needles" excessively.

Frequently the spring which controls the tension between the negative carbon and the V-shaped rest loses its temper, and as a result the carbon arcs at the V rest and spindles excessively. In some types of lamps a weight is used instead of a spring. It is good practice to test the tension between the carbon and the rest after each reel.

Meter Checking

Another operating fault which is common, not only to high intensity lamps, but to all lamps, as well, is the overloading of carbons. Carbons, like other manufactured articles, have physical limitations. If a carbon designed for 100 amperes is burned at 130 amperes, the natural result is short life and spindling. If carbons

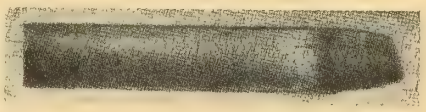


Figure 29

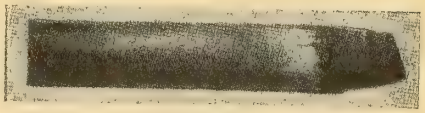


Figure 30

are spindling, the first move should be to check the amount of current drawn at the arc.

It frequently happens that the wall ammeters have not been calibrated since they were installed, and as a result are not reading correctly. This is no reflection whatever on the make or type of ammeter in use as ammeters are very sensitive and consequently require attention from time to time. We have found ammeters off as much as 20 amperes. If your ammeter has not been checked for some time, our suggestion would be that you have the power company supplying your current check the current at the arc for you.

(Conclusion)

Vacuum Tube Test for Western Electric Sound Projector System

By R. H. McCULLOUGH

The following instructions for tube testing were compiled by R. H. McCullough, Supervisor of Projection for Fox West Coast Theatres, and were incorporated in a bulletin on the subject which was sent to all units of that theatre chain. The instructions are concise and thoroughly cover the subject of tube testing, thus making a valuable addition to every projectionist's store of information.

THESE instructions are outlined for the purpose of standardizing the tube tests made on Western Electric sound projector systems. Any tube failing to meet the following requirements will be considered as unsatisfactory for use. All tubes, with the exception of KS-6243 exciting lamps, will be replaced free if they fail to meet these requirements before they have given a useful service for 100 hours.

239-A Tubes

These tubes shall be tested in the first socket of the 41-A Amplifier. In case the installation is of the older type, where the 41-A Amplifier is not included, the tubes should be removed from the theatre and taken to a theatre where a 41-A Amplifier is installed.

(a) Adjust all currents and voltages of the system to their normal operating values.

(b) Place the tube to be tested in the first socket of the 41-A Amplifier.

(c) Vary the filament current, between the limits of .220 amps. to .270 amps.

(d) While varying the filament current, as noted under (c), hold the plate current button of tube number one in.

(e) During the above operation, the plate current, as noted on the plate current milliameter, shall not vary beyond the limits of 1.3-5, 1.6-5 milliamperes.

(f) Any tube falling outside the limits specified under (e) shall be considered as defective.

(g) Adjust the filament current to .270 amps with all tubes in position in the 41-A Amplifier.

(h) Note the plate current reading of tube number one, by operating the proper push-button. Remove this tube and the tube in socket number two; place number two tube in socket number one, and tube number one in socket number two; operate the push-button of socket number one and observe the plate current value of this tube. Similarly interchange tubes two and three, and observe the plate current of tube number three in socket number one. In other words, observe the plate current values of all tubes in socket number one, while holding the filament current at .270 amps.

(i) Use the tubes as follows:—

1. Tube with highest plate current value noted when making test (h) to be used in socket number three.
2. Tube with next highest plate current to be used in socket number one.
3. Tube with lowest plate current value to be used in socket number two.

NOTE: It is to be understood that the tubes referred to in paragraph (h) and (i) must first have tested satisfactorily under the tests outlined in paragraphs (a) to (f) inclusive.

205-D Tubes

All 205-D tubes shall be tested in the first socket of the amplifier position of the 42-A Amplifier or in the third socket of the 8-B Amplifier. This includes the 205-D tubes used in the motor control boxes. Proceed with the test as follows:—

42-A Amplifier Test.

(a) Place the tube, to be tested, in socket number one in the amplifier position of the 42-A Amplifier.

(b) Adjust all voltages and currents of the system to their normal values.

(c) Remove tube number two from the amplifier position of the 42-A Amplifier.

(d) The indicated plate current value of the remaining tube under test shall be between the limits of 25-45 milliamperes.

Tube Balance.

It is important that the two rectifier tubes and amplifier tubes be balanced. Proceed with balancing test as follows:—

Equip the 42-A Amplifier with four tubes, which have complied with the requirements as specified under paragraphs (a) to (d) inclusive.

(e) Remove one of the amplifier tubes and observe the plate current value. Replace this amplifier tube and remove the remaining one. Observe the plate current value. The two values of plate current should be within 5 milliamperes of each other. If they are not within 5 milliamperes of each other, select a tube from the spare supply which will give an indicated value within the limits. In other words, the amplifier tubes when tested individually must match each other within the limits of 5 milliamperes. In cases where it is necessary to remove a tube from the amplifier, because of difficulty in obtaining proper balance, the tube should be labeled with the indicated plate current value and placed in the spare parts cabinet. If the tube is labeled, it will minimize the labor of re-testing when selecting a tube for balance at some future date.

(f) 205-D Tubes which are used as rectifiers, shall be balanced as noted under paragraph (e).

(g) It is to be understood that a balanced pair of rectifier tubes must, when used in combination with a pair of amplifier tubes, give a combined plate current reading within the red limits inscribed on the face of the plate current milliameter.

8-B Amplifier Test.

In testing 205-D tubes in the 8-B Amplifier, proceed as follows:

(a) Adjust all currents and voltages of the system to the normal values.

(b) Insert tube to be tested in the third socket of the 8-B Amplifier.

(c) Insert the plugs of the 514-A meter panel in the proper jacks for reading the filament and plate currents of the third-stage tube in the 8-B Amplifier.

(d) Vary the filament current of the tube under test from 1.4 to 1.6 amperes.

(e) While making the variation noted under (d), observe the plate current values of the tube under test.

(f) If the plate current values noted vary outside the limits of 16 to 28 milliamperes, the tube is not satisfactory for use.

102-D, E. F. & G. Tubes

The above tubes shall be tested in the first socket of the 8-B Amplifier. Proceed with the test as follows:—

(a) Adjust all voltages and currents of the system to normal values.

(b) Insert the tube, to be tested, in the first socket of the 8-B Amplifier.

(c) Insert the plugs of 514-A Meter panel in the proper jacks for reading the plate and filament currents of the first tube in the 8-B Amplifier. Adjust the filament current to .97 amperes and observe the plate current value, which shall be within the limits of .0005 to .001 amperes.

(d) Vary the filament current from .97 amperes to .90 amperes and observe the plate current.

(e) Varying operation, the plate current shall not vary more than .00015 amperes.

211-E Tubes

These tubes shall be tested in either the

43-A or 10-A Amplifiers. Proceed with the test as follows:—

Filament suspension spring test.

The filament in the 211-E Vacuum Tube is held tight by compression spring supports located on top of the insulating block, which are located at the extreme upper end of the tube element assembly. The purpose of these springs is to compensate for changes in filament length, which occur due to variations in filament temperature.

In case the springs do not function properly, they will permit the filament to sag and come in contact with the grid resulting in a short circuit in the filament and grid. In case this occurs, the 43-A Amplifier Power Supply Transformer will be burned out. In order to guard against this, before placing a new tube in service, proceed with the following test.

(a) Make sure that all current supplies to the system are disconnected.
(b) While observing the suspension springs with the aid of a magnifying glass, apply the normal filament current only, to the tube under test. As the filament becomes heated, there should be a perceptible upward movement of the suspension springs.
(c) After the filament has attained normal operating temperature, disconnect the current supply. As the filament cools off there should be a noticeable downward movement of the suspension springs.
(d) In case no movement can be noted, as outlined under paragraphs (b) and (c), the tubes shall be rejected.

Filament Emission and Balance Test

43-A Amplifier Method.

(a) Place the tube, to be tested, in socket number one in the amplifier position of the 43-A Amplifier.
(b) Adjust all voltages and currents of the system to their normal values.
(c) Remove tube number two from the amplifier position of the 43-A Amplifier.
(d) The indicated plate current value of the remaining tube under test shall be between the limits of 50-115 milliamperes.

Tube Balance.

It is important that the two rectifier and amplifier tubes be balanced. Equip the 43-A Amplifier with four tubes, which have complied with the requirements as specified under paragraphs (a) to (d) inclusive.

(e) Remove one of the amplifier tubes and observe the plate current value. Replace this amplifier tube and remove the remaining one. Observe the plate current value. The two observed values of plate current should be within 10 milliamperes of each other. If they are not within 10 milliamperes of each other, select a tube from the spare supply, which will give an indicated value within the required limits. In other words, the amplifier tubes, when tested individually, must match each other within the limits of 10 milliamperes. In cases where it is necessary to remove a tube from the amplifier, because of difficulty in obtaining proper balance, the tube should be labeled within the indicated plate current value and placed in the spare parts cabinet. If this suggestion is carried out, it will minimize the labor of re-testing when selecting a tube for balance at some future date.
(f) 211-E Tubes, which are used as rectifiers shall be balanced as noted under paragraph (c).
(g) It is to be understood that a balanced pair of rectifier tubes must, when used in combination with a pair of amplifier tubes, give a combined plate current reading within the red limits inscribed on the face of the plate current milliameter.

10-*A Amplifier Method.*

(h) Place the tubes, to be tested, in the sockets of the 10-A Amplifier.
(i) Adjust voltages and currents of the system to normal.
(j) Reduce the filament voltage of the 10-A Amplifier tubes to 5 volts.
(k) Remove one tube from each side of the amplifier.
(l) Adjust the filament voltage of the amplifier to 10 volts.
(m) Remove one tube from the amplifier and note the plate current reading of the remaining tube, which should be within the limits of from 40 to 100 milliamperes.
(n) Replace the tube just removed and remove the tube just tested, and observe the plate current value. The two tubes should test within 10 milliamperes of each other.
(o) Remove the two tubes just tested and insert the first two tubes originally removed as specified under operation (k). Test these two tubes, as outlined under operations (1) to (n).
(p) Care should be taken to run off the plate supply to the tubes when removing or replacing them in a socket. Otherwise, there is danger of causing a high voltage flash over. In performing operation (o), care must be taken to warm up the two cold tubes, which are placed in the amplifier for test.
(q) When the Amplifier is equipped with four tubes, meeting the requirements as outlined above, and all voltages and currents adjusted to normal, a current reading on the 10-A Amplifier milliameter shall be obtained; the value of which shall be within 175 to 250 milliamperes.

219-D Tubes

A 219-D Tube shall be considered as satisfactory, as long as it will supply normal voltage to the remaining tubes in the system when all remaining tubes in the system are satisfactory. When a pair of 219-D tubes become badly out of balance, there will be a perceptible hum and vibration present in the 6000-A rectifier.

An indication of low filament emission is a noticeable increase in the operating temperature of the tube. Usually the plate of a tube, which has low filament emission will become very red as compared with the plate of a normal 219-D tube. Any tube, which shows signs of becoming white hot, should be removed from the rectifier as there is danger of the plate melting down and causing damage to the supply transformer.

KS-6243 Exciting Lamps

The lamps are not satisfactory for use when a perceptible film of tungsten vapor has accumulated on the inner surface of the glass bulb between the filament and the end of the lens tube. It is permissible to operate a lamp, which has become blackened at the upper end, providing the glass surface, between the filament and the end of the lens tube, permits unobstructed passage of the light.

It is necessary that each projectionist, upon installing tubes in the amplifiers and control boxes, label each tube with a small sticker, marking date and time installed, so that each projectionist may keep check on tubes to see if they have given 100 hours' service without deterioration. Any tube, which does not give 100 hours' service, will be replaced free of charge.

It is well to note that operating an amplifier with flat tubes will eliminate high frequency and cause considerable distortion. It is to your advantage, as well as to the theatre's advantage, to see that the sound in theatres is 100 per cent perfect in order to avoid severe criticism.

S. M. P. E. Abstracts

THE following abstracts from papers which were presented at the Fall Meeting of the Society of Motion Picture Engineers, in session at Toronto, Canada, October 7 to 10, are particularly interesting to projectionists. W. B. Rayton, Bausch & Lomb Optical Co. technician, offered a paper titled "The Optical Problems of Wide Film Motion Pictures," from which the following abstract is taken:

The motion picture industry seems to be about to adopt film wider than the standard 35 mm. film now in universal use. Such a step imposes very grave burdens on the optical systems required for photography and projection. Both in photography and in projection, lenses have been called for which, while maintaining the high speed and fine definition necessary for the conditions in the studios and theatres, must cover hitherto unrealized fields of view.

In projection, the question of illumination bristles with difficulties.

New Wide Film Lens

The Bausch and Lomb Optical Company has been cooperating with the sponsors of wide film motion pictures by designing the new lenses involved. New photographic lenses which cover a picture area 23x46 mm. at a speed of f:2.3 in focal lengths as short as 50 mm; new projection lenses which will project, with beautiful definition, pictures of this size in focal lengths as short as 3 inches; and new condensers to bring the brightness of the projected

picture up to a satisfactory level have been perfected.

Another phase of wide film was treated in the paper *"Some Practical Aspects and Recommendations on Wide Film Standards,"* by Messrs. A. S. Howell and J. A. Dubray. This paper is divided into three parts, the first taking into consideration the psychological and artistic factors which suggest the recommendation of a change from the present standard in the form and dimensions of the film, the second containing suggestions for film dimensions, and the third dealing with the mechanical alterations necessary to a general introduction of wide film in the industry. An abstract of this paper follows:

The paper is divided into three parts, the first taking into consideration the psychological and artistic factors which suggest the recommendation of a change from the present standard in the form and dimensions of the motion picture frame. The recommended frame shape is that of a rectangle whose sides are in the ratio of 3 to 5.

Film Dimensions

In the second part of the paper, the authors suggest three film dimensions which are respectively called the "Economic Ideal," the "Spectacular," and the "Extreme," which differentiate from each other in their picture area and in the length and width of the sound record, which is assumed to be printed on the same film as the picture record.

The problems involved in the adoption of any of the three dimensions are analyzed in regard to size, shape and position of the perforations, also in regard to the possible influence that the larger-size film would have on sound recording. A brief discussion is presented on the engineering developments which would be necessitated by the adoption of the new standards in regard to film shrinkage; and the problems that are involved by their adoption in regard to the photographic and projection optical system are considered.

Urge Standardization

The third part of the paper deals with the mechanical alterations that the adoption of the new standards would bring forth, with due consideration of the economical factors involved.

The paper concludes by suggesting the formation of a special standing committee, which should include representative members of all branches of the motion picture industry, and which should be given power and authority to discuss and take definite decisions in regard to the creation and adoption of new dimensional standards.

Electrical Measuring Instruments

ELECTRICAL meeasuring instruments should be handled carefully and not subjected to any jars or hammering. Portable instruments are often placed in positions where they are subjected to a strong magnetic field or to high temperatures. Both of these cause errors in the reading.

In the permanent magnet type of direct current instruments, if the temperature is increased the strength of the magnets will be decreased which tends to decrease the reading of the instruments, but at the same time the strength of the holding spring will be decreased and these two errors tend to neutralize each other. As a general rule, however, these meters will read low when they are hot.

In the ammeters of this type with an internal shunt, the heat from the shunt will usually cause the instrument to read low. Up to about 25 amperes these meters read correctly, but above that they should not be left in the circuit at all times. Direct current meters for reading large currents should be provided with an outside shunt.

Shielding Meters

Errors will be caused by stray magnetic fields, the size depending upon the strength of the field. An alternating current field, if weak, will not affect a direct current meter, but if strong it will exert a demagnetizing effect upon the meter and cause a low reading. These fields may be caused by any electric generator or motor, a conductor carrying current, or by other meters. Switchboard meters should be shielded from the effect of these fields by an iron case.

Other causes of errors which may be mentioned are the friction of pivots, defective springs and lack of balance of moving parts. These faults, however, should not be found in well-made meters.

For measuring A. C., current transformers and not shunts should be used. Care should be taken that no more meters are connected on the secondary of the transformer than the number which it is designed to carry. At light loads the ratio of transformation is not accurate and small errors will be introduced. The secondary of both current and potential instrument transformers on high potential lines should be grounded. This not only protects the operator but prevents errors due to static electricity.

Meter Inspection

In the A. C. induction meters the error due to small changes in frequency should be slight. Rattling and humming of meters is caused by loose parts. In the D. C. wattmeters the case may become permanently magnetized and affect the reading.

Wattmeters should be inspected at least once a year when they should be thoroughly cleaned and the pivot at the bottom oiled. The creeping of wattmeters is usually due to vibration of the wall on which they are fastened. The potential coil is connected to the line at all times and this in connection with the starting coil gives a small torque. Another cause is the connection of a meter on a higher voltage than that for which it is adjusted. A good wattmeter should give accurate readings on both light and heavy loads under a wide variation of power factor, frequency and wave form. The damping magnets should not lose their magnetism and the case should be moisture, bug and dust proof.

Good electrical contact is extremely important with all measuring instruments. This is particularly important in the low reading milli-voltmeters when used for measuring current with external shunt. If the resistance of the meter is only a few ohms, a corroded or dirty terminal may introduce a large percentage of error.

Voltmeter Testing

The voltmeter is merely a galvanometer of high resistance connected across two conductors of opposite polarity. The resistance of the voltmeter is extremely high in comparison with that of the conductors, and but a minute current flows through it. As this resistance is fixed the only way to vary the current flow is to vary the electromotive force.

An increased electromotive force will increase the current flow and likewise a decrease of one will decrease the other. And these current variations produce corresponding deflections of the needle. The deflections show actually the changes of electromotive force. The scale divisions are calibrated or given a value in volts either by using electromotive forces of known value or by means of a standard voltmeter.

Tests with a Voltmeter

The voltmeter is used for a wide range of tests. On electrical machinery the voltmeter is used for ground tests, insulation tests, resistance tests, short-circuit tests, open coil tests. The inside electrical worker uses a voltmeter for circuit ground testing in conduit circuits, metal moulding circuits, armored cable circuits, etc.

The Ohmmeter

The ohmmeter is a very practical instrument for accurately recording the resistance of a coil or circuit for which the resistance in ohms is desired. The ohmmeter operates in a manner somewhat similar to a wheatstone bridge. The ohmmeter will do a similar range of work as done by the bridge and it costs one-half the price. In everyday practice the ohmmeter is used for all sorts of electric current and electric heating circuit resistance tests. A wide range of tests in radio manufacturing is covered using an ohmmeter.

Film Fire Statistics

Seventy-one per cent of all theater fires originate in the projection room while machines are in operation, causing hundreds of fires annually and resulting in a yearly loss of approximately $3,000,000 to theatre properties and equipment. Losses sustained from destroyed film in theatre fires, which are not included in the $3,000,000 total, would send this figure considerably higher.

Theatres suffered an $18,000,000 loss during the five years from 1922 to 1926, inclusive, with the average for recent periods being lower, due, principally, to the many new devices and types of equipment now being built to eliminate fire hazards.—*The Film Daily.*

Color Film Processes

By EMERY HUSE
Motion Picture Film Dept., Eastman Kodak Company

A YEAR ago the motion picture industry generally, and Hollywood particularly, was just entering seriously the field in sound photography. At the present moment color photography, or rather the anticipation of it, is in the minds of all motion picture producers. It is the desire of the author of this article to call to the attention of those interested in the general subject of color some of the underlying physical facts of color photography together with a historical résumé of what has been done in this field.

One must first go back appreciably and review somewhat some of the fundamental facts in the study of light. From the physicist's point of view, the study of light is a study of activity which originates in luminous bodies and causes the sensation of vision when it enters the eyes. There are two distinct phases in the study of light: first, *quantity*, which deals with differences in brightness and, second, *quality* differences are classified under the phenomena of color.

Newton's Contribution

Sir Isaac Newton made many advances in the study of light and his many experiments led him to believe in a certain hypothesis. Newton was the first to get a clear idea of color, which idea he attained through a study of glass prisms. He was the chief advocate of the corpuscular theory which maintained that light consisted of very minute weightless material particles. It is rather a strain on the imagination to think of material corpuscles flying with enormous speed through a solid substance like glass with so little hindrance as glass seems to offer to the passage of light. It is also somewhat difficult to explain the phenomena of reflection and refraction under this theory. Color was accounted for by differences in size and shape or in some other characteristics among the corpuscles.

The newer, and at present accepted, theory considers light as made up of waves acting in much the same way as waves produced by disturbances in a body of water. Under this theory there is little difficulty in explaining reflection and refraction. Furthermore, color is accounted for very simply by the supposition that differences in color correspond to differences in the length of the waves. The medium in which these waves act is termed "ether," which means that empty space has properties other than mere extension; properties that enable disturbances carrying energy to pass through, the passage requiring finite time. We know that light travels at a rate of approximately 186,000 miles per second.

Theories of Color Vision

Prior to actual work on the recording of color photography, it is necessary to consider somewhat the theories of color vision. One, that of Young and Helmholtz, is a purely physical theory, while another, that of Hering, is psychological. These two theories are given considerable weight. The Young-Helmholtz theory considers that the retina consists of three distinct sets of nerve fibers, each giving a single sensation, one set a red sensation, another a green, and the third a blue-violet sensation.

The Hering theory deals with three primary sensations and postulates certain contrasts caused by chemical changes under the influence of light in three hypothetical fluids.

Our present existing knowledge teaches us that there are three primary colors, and these three colors are blue, green and red. Newton at one time advanced the theory that there were seven primaries. However, based upon work by physicists and psychologists, it is pretty well established that blue, green, and red are considered universally as the three primaries.

Color Photography

Three-color photography is based on the fact first discovered by Clerk Maxwell about 1860 that all colors can be matched by a mixture of the three primary colors, red, blue, and green, if the proportion of these constituent colors be rightly chosen. The work of Maxwell was based on the discovery by Young in 1807 that all color perception is the result of three fundamental color sensations singly or in various combinations and proportions, and it is safe to say that the work of Maxwell is the foundation upon which three-color process of natural color-photography is based.

Prior to Maxwell's time such men as Seebeck, Becquerel and Daquerre did quite a little experimental work on the reproduction of color, but they were handicapped by the fact that they could give only a partial reproduction and had no way to fix their images.

Workers in the Art

Later on, natural color photography necessitated the use of a light sensitive dye which dye faded out to a colorless substance. A dye is decomposed only by the light which it absorbs, which color is complementary to its own color. Certain aniline dyes bleach comparatively rapidly in light, hence after three such dyes are chosen so as to form the three fundamental colors, red, green and blue-violet, and these are coated on a white surface such as paper in three separate layers and the whole exposed to a colored object, in red light, the blue and green dyes are bleached out, leaving the red. In the same way in blue light, blue will be left as red and green are bleached out, and in the case of green, red and blue are bleached out, while the colors which are mixtures of these each will be bleached in direct proportion to the amount of the fundamental colors present.

Processes based on this principle were conceived by such men as Cros in 1861, Leisegand in 1889, Ives in 1891, and others up until 1910.

Despite the apparent simplicity of the process, it has never furnished a satisfactory solution to the problem of natural color photography. It was difficult to secure three dyes having the proper color and of identical light sensitiveness, and it was further difficult to prevent further bleaching of the dye after exposure.

In 1897, Prof. Lippman, of Paris, devised an ingenious process of color photography dependent upon the principle of light interference. Lippman's method was to expose a specially prepared fine-grained transparent emulsion of silver chloride in contact with a bath of mercury which reflected back into the emulsion the waves of light which reached it, thus setting up in the sensitive film the phenomena of interference. This process, however, although extremely interesting, was little more than a laboratory experiment from the standpoint of producing photography in natural color.

This brings us back to the time of Maxwell, who, as previously stated, did the basic work on the principle of three-color photography.

The Additive Process

In natural color photography there are two very general classifications, the additive and subtractive processes. As a general statement the additive process of color photography can be summed up in the statement that we start with a colored light from which we produce white by addition. In other words, we take red, green and blue and by an additive method produce a white light. Photographically, this process may be analyzed as follows:

The color sensation negative records by density the presence of that particular color in the subject, i. e., the red sensation negative records the red of the subject in terms of greater or lesser density, according to the amount of red present in the various portions of the subject. A positive transparency from this negative will reproduce the red sensation by means of its clearer parts. The parts of the subject containing the purest red will be represented by clear glass, those parts with some red by a medium density, while those parts containing no red whatever will be of maximum density. Now if this transparency is viewed in red light it will reproduce the red sensation of the original subject. In a like manner the blue and green transparency will, when viewed in blue and green light, reproduce the respective color sensations of the original subject.

The three records may now be combined and the natural colors of the subject

(*Continued on page 36*)

*International Photographer.

$1,000 to fulfill

ANNOUNCING A NATION-

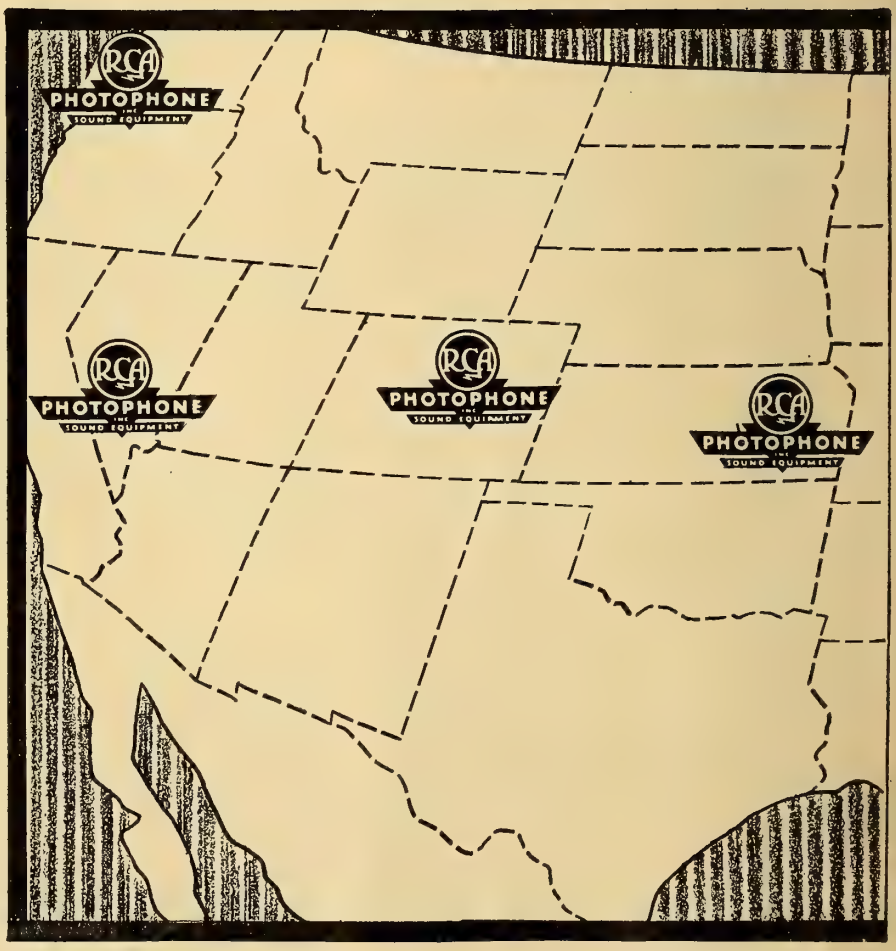
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2 *The fairest prices compatible with that quality.*

3 *Prompt and efficient service in the maintenance of that equipment.*



RCA Photophone has kept its promise to produce a superior sound system at an equitable price. It is the world's lowest priced, high-quality sound apparatus—the ultimate in tone and precision.

But what is not so generally known are the steps which RCA Photophone has taken to provide prompt and efficient service for its equipment.

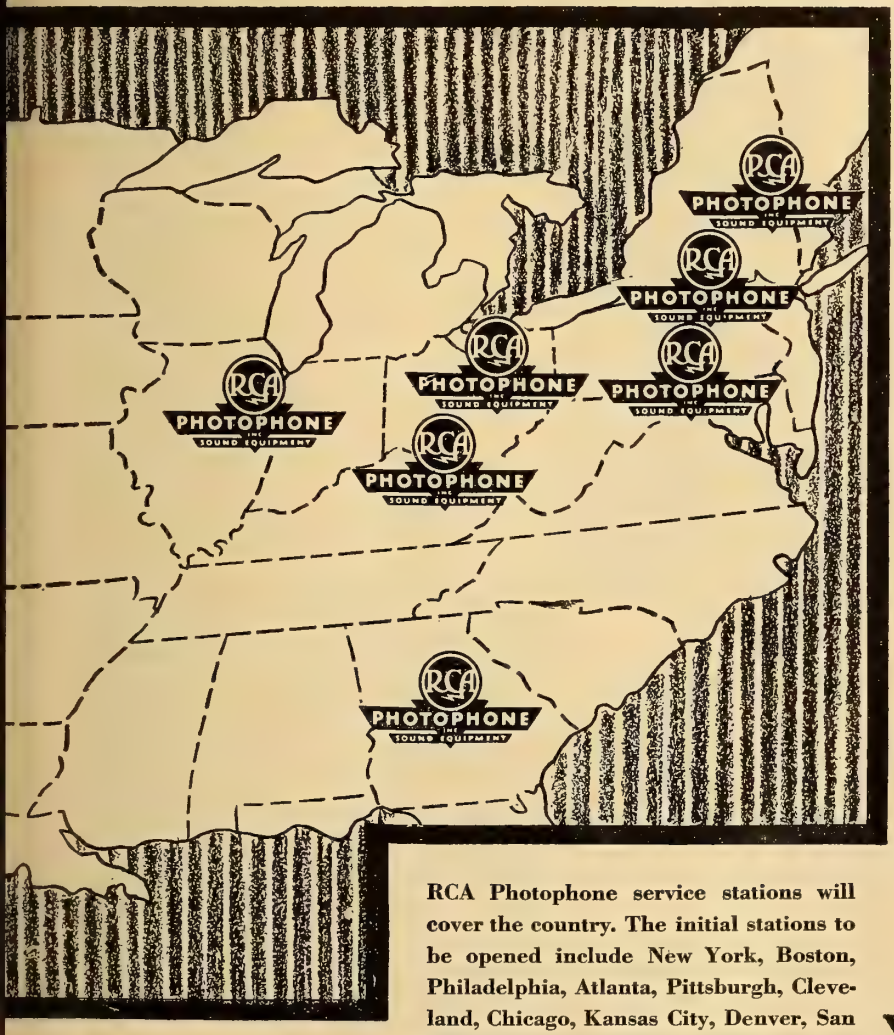
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RCA Photophone service stations will cover the country. The initial stations to be opened include New York, Boston, Philadelphia, Atlanta, Pittsburgh, Cleveland, Chicago, Kansas City, Denver, San Francisco and Seattle. Others will be opened as rapidly as occasion demands.

Now this story can be told. After months of preparation RCA Photophone announces the formation of a nation-wide network of service stations. The first eleven of these branches are now being opened. Each will be in charge of a supervising engineer and an assistant engineer, with a corps of factory-trained technicians as their aides. These experts are your assurance of a satisfactory performance.

RCA Photophone wants satisfied customers. It will go to any length to insure their satisfaction. To this end, RCA Photophone will spend more than a million dollars a year to carry out its ever-expanding program of service to the exhibitor—a program that considers only the results—not the cost.

RCA PHOTOPHONE INC SOUND EQUIPMENT

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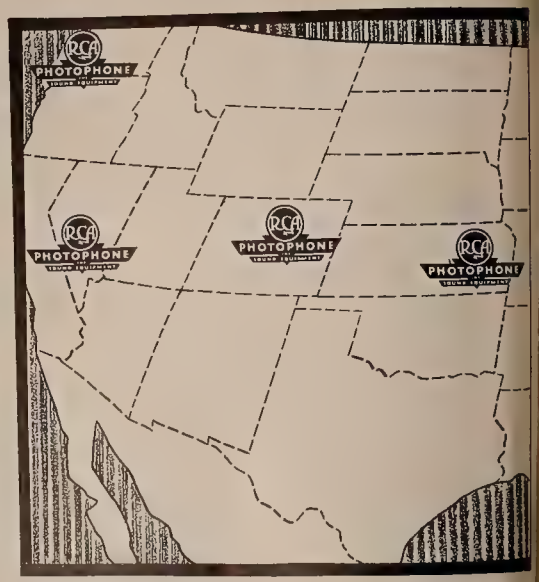
RCA PHOTOPHONE SERVICE STATIONS

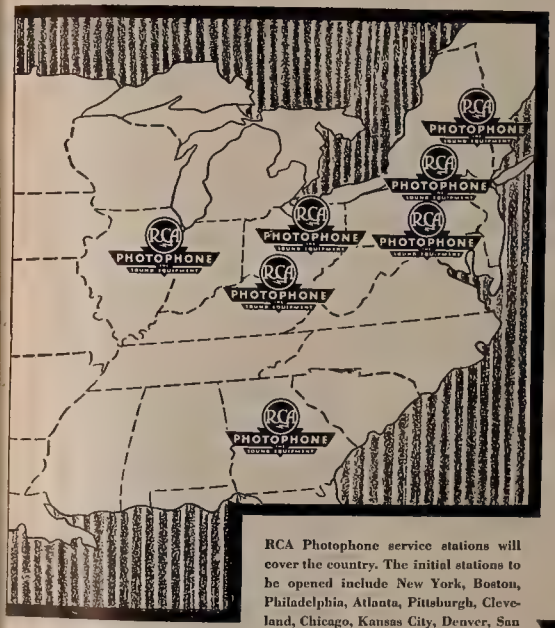
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Equipment Troubles and Maintenance

By C. R. TRAVIS

THE majority of sound projection equipment manufacturers are endeavoring to give the theatre owner as much service as possible in the matter of maintaining the efficiency of the apparatus which he has purchased from them. One of the best ways in which to render this service to the exhibitor is to place at the disposal of his projectionist who daily handles the equipment every opportunity and facility for learning the details of the system. Co-operation with the projectionist in this respect is one of the most important functions of any merchandising plan for sound equipment, and I speak now from experience in just such a capacity.

In the last analysis it is the projectionist to whom the exhibitor looks for results obtained with any given equipment. Lacking the technical knowledge to enable him to accurately judge the worth of an equipment, the exhibitor must necessarily place full trust in his projectionist. Sound equipment manufacturers recognize the projectionist's responsibility in this respect and they are therefore ever on the alert to see that his wishes with respect to the equipment are carried out. It is undoubtedly true that in the past a cloak of secrecy was thrown about certain parts of sound systems, yet in the light of past experiences in the development of any new art, this condition is entirely understandable.

Observe Servicing

In the case of the larger companies regular service inspections assist the projectionist in maintaining the efficiency of his equipment; but with the smaller distributors the burden of maintenance and "trouble shooting" is usually transferred to the projectionist.

Trouble-shooting is not a haphazard procedure. To be successful it must be rapid and well-ordered, and the few simple tests necessary must be made thoroughly and a definite "yes" or "no" received before proceeding with the next step. The projectionist by every consideration is entitled to know as much as possible about the equipment he is called upon to operate. A good time to obtain much useful information is while the engineer is making the installation, for during this period many of the common troubles of the system will show up. Lacking this opportunity, the projectionist should observe closely the work of the service man on his periodic visits.

Essentials All Alike

Essentially all sound reproducing systems are alike. They may differ in external appearance, in size and shape, in the amount of space they occupy, and in the quality of delivered results, yet they all are substantially the same. They all have been designed to do the following work:—change mechanically or photographically-recorded sound into electrical energy, supply a means for controlling the amount of energy passing a certain point, a means for amplifying this energy to requisite levels, and a means for changing this amplified energy into sound.

The conventional designations for the equipment performing these four operations are as follows: In the reproduction of wax records the term "pick-up" or "reproducer" is most commonly used. In film reproduction the usual terms employed are "film reproducer," "sound head," and "film attachment." The means for controlling the electrical energy passing a certain point is known as the 'fader." A key or switch provides the means for connecting the fader to either the film or disc attachments of the projector.

The amplifier performs the function of building up the electrical energy to the required level. The horns or loudspeakers transform the electrical energy into sound. In future issues of this publication, each of these units with their common troubles will be covered in detail. In this installment we shall discuss methods of tracing one of the major troubles of any system.

"No Sound" Common Trouble

"No Sound" is of course the most common trouble. To one who is familiar with his equipment this trouble should offer little difficulty. We should remember that the entire apparatus does not suddenly cease functioning, and it is rare indeed that more than one trouble develops at one time. "No sound" is always due to the breaking of some particular unit in the complete circuit.

Let us assume first that all keys, switches and other accessories are in their correct operating positions. A few seconds should suffice to check up on this point. One of the first impulses of most projectionists when the equipment "goes dead" is to run to the amplifier panel, but in nine cases out of ten they fail to locate the trouble there. The amplifier is to be checked, of course, but when trouble occurs, *start at the beginning*—either at the sound head or at the disc pick-up, depending on whether you are running sound-on-film or discs. *After* checking your connections, photo electric cell, exciter lamp, etc., *then* proceed to check the equipment step by step to the amplifier.

In Figure 1 there are shown connections in a general circuit which should be remembered before any trouble hunting becomes necessary. This diagram shows that about the closest point one can get to the electrical center of the system is at the input to the amplifier. If one can determine whether or not energy is reaching this point, one can definitely isolate the trouble into a certain section of the equipment.

Amplifier Input Check

Let us say we find that energy *is* being received at the input to the amplifier:—we then may be sure that the trouble lies ahead of this point. If no sound is heard, we may be sure that the trouble lies in back of this point. A pair of headphones of good quality will respond to the energy received from the reproducers at this point—that is, with the fader at the top step.

Another quick test for "no sound" location to either one side or the other of the electrical center of the system is to tap the first tube in the amplifier with a finger. This tap jars the tube elements and sets up a small wave that should be audible in the stage horns or in the projection room monitor. If the amplifier from the first tube to the horns is working as it should, this sound will be heard in the horns, and it would be logical to assume that the first half of the system is in trouble. If the ringing sound is not heard in the horns, then one may assume that the last half of the system is not working.

Assuming that the test indicates trouble in the first half of the circuit, our next task is to locate the trouble either in the pick-up elements (disc or film), or in the fader. The check at this point is much the same as that at the amplifier.

Listen with a headset to the output of the pick-ups (input to the fader), at the

(*Continued on page 38*)

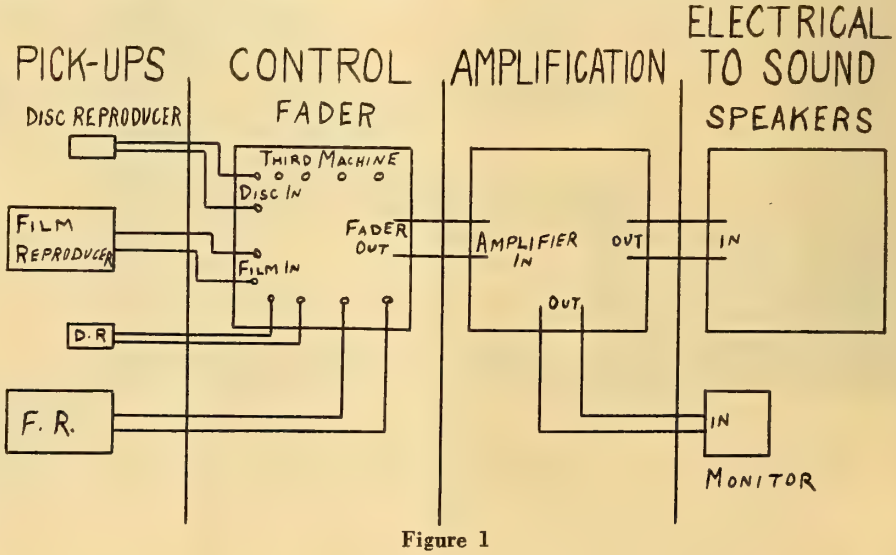


Figure 1

Dependable Equipment

Essannay Announces Strong's New "Five-Point" Changeover

A NEW complete multiple projection room accessory combining in one device five essentials which are requisite for good projection results has been announced by the Essannay Electric Mfg. Co. of Maywood, Illinois. This new equipment unit is the product of L. D. Strong, president of the Essannay Co., whose experience as a practical projectionist emphasized the need for a single projector mounting which would automatically perform all the functions heretofore obtainable only in several individual units.

That the term "five-point" which Essannay has applied to this device is no misnomer is indicated by the fact that the mounting includes the following features: (1) A noiseless changeover, (2) An eye shield, (3) Framing light, (4) An automatic fire shutter finger, and (5) A film gate opener. The device is guaranteed to perform all of these functions, with the mechanical changeover and fire shutter designed to perform their work quietly, instantaneously and efficiently.

Rigorous Test Period

This novel Strong device has been ready for distribution for the past two months, but it was not placed on the market for the reason that its maker wished to test thoroughly whether it would perform satisfactorily everything that was claimed for it. With this end in view one of the changeovers was installed in the State Lake Theatre in Chicago where it was subjected to exhaustive tests under actual operating conditions for more than 200 consecutive performances. This test showed that the device was capable of delivering maximum efficiency on all five points under even the most severe conditions.

The accompanying illustrations show some of the more important features of this new Strong changeover. Figure 1 shows the complete changeover assembly mounted on a projector as viewed from the operating side. This keyed picture indicates the position in the assembly of the various important units.

For example, the framing light is a 110-volt, 21 C. P. tungsten light which, Essannay claims, will enable the projectionist to have a strong direct light trained on all framing operations. The switch for the framing light is conveniently located. The glass eyeshield is warranted not to leak light, a condition which has long been a source of danger for the projectionist's eyes. Also indicated in this illustration are the handle for opening film gate, the lever for hand use, the changeover shutter blades, and the holes for oiling. The framing light is ingeniously located in the assembly and insures maximum lighting for all framing work.

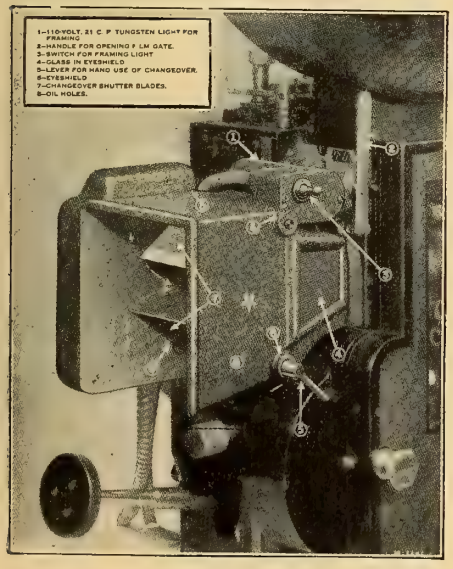


Figure 1

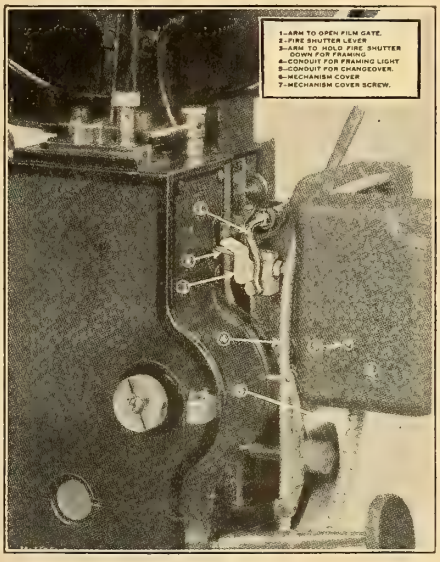


Figure 2

Figure 2 shows the changeover mounting from the reverse side of the projector. Indicated on this keyed illustration are the arm for opening film gate, cover screw, arm to hold fire shutter down for framing, fire shutter lever, and conduit arrangement.

The heart of the changeover is shown in Figure 3, which shows the operating mechanism with the outside cover detached.

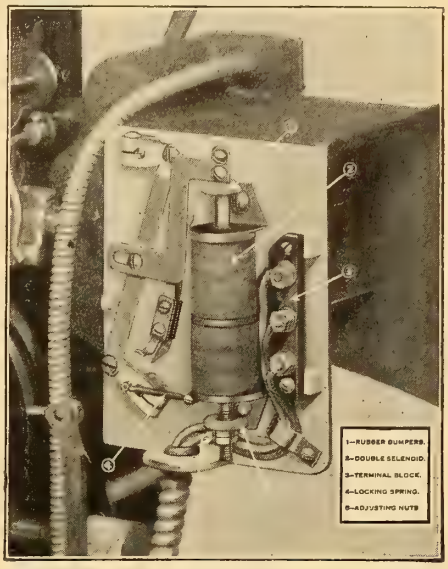


Figure 3

The precautions which have gone into the design and manufacture of this changeover are apparent from this view of the mechanism. Special rubber bumpers are standard thereon, insuring quiet, efficiency and long life, while another advantage is the use of double selenoid.

For Simplex and Motiograph

Essannay reports a considerable demand for this new product even before it has been formally announced from projectionists who have had the opportunity of testing several trial assemblies. With the combination of five essential projection aids in one compact, sturdily-built and performance guaranteed unit, Essannay anticipates much enthusiasm about the device from projectionists.

This new Strong changeover is suitable for use with either Simplex or Motiograph projectors. Distribution of the unit is through all branches of the National Theatre Supply Co. Foreign orders are handled through Edward L. Klein, 25 West 43rd St., New York City.

NEW HOUGH HORN LIFT

The new Hough horn lift is installed under the stage floor and is operated automatically. When not in use, the horns are thus housed under the stage floor itself. It is contained within a ceiling height of 8 feet below the stage and has a full upward travel of 15 feet, or more, if required. It is powered by a 1½ h. p. motor, driving a cable-consuming drum through a ball-bearing steel and bronze worm gearing and operates in a dust-proof oil bath. Travel up and down is smooth and without vibration, time required for a trip being 45 seconds. Operation is absolutely silent.

in the Laboratory

Conducted by SAMUEL WEIN

Sound Recording with the Piezo Crystal

ALMOST every conceivable means of varying a light source has been recommended and tried as a means for recording sound photographically on motion picture films. These divers methods have met with more or less gratifying success. However, the "piezo effect" is one of these methods which shows "food for thought" to those who might desire to ascertain the availability of the process for commercial sound recording. R. V. L. Hartley[1] patents the use of the piezo effect for this purpose, and we are herewith quoting this data.

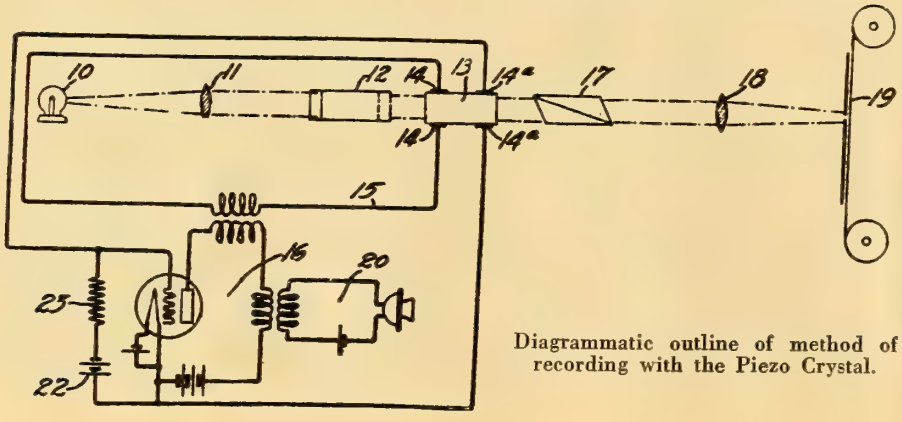
The piezo effect consists of a crystal of Rochelle salts (sodium potassium tartrate), held under compression by two metal plates. If a potential is applied to the two plates, the crystal will vary in its physical characteristics to such an extent as to pass light through it. The piezo effect has other characteristics which make it adaptable for other purposes, but since we are not concerned with these other properties and applications, we are not considering them here.

In the accompanying drawing we see a source of light, 10, is focussed through a lens, 11, and a Nicol's prism, 12. Adjacent the opposite face of the Nicol prism and arranged to receive light from same is a Rochelle salt crystal, 13, having on opposite faces metallic deposits, 14, to which are electrically connected the secondary of a transformer, the primary of which is connected to the output of a vacuum tube oscillator, which latter is impressed on the piezo crystal.

The straining of the crystal due to its vibration causes rotation of the plane of polarized light transmitted to it twice during each cycle of vibration. A second Nicol prism is arranged to receive light transmitted through the crystal, 13, and is adjusted so that it is crossed with respect to the prism, 12, when the crystal, 13, is at rest. Thus when the crystal, 13, is vibrated, light is transmitted from the source, 10, through the combined prisms and crystal, and the amount of transmitted light is dependent upon the extent of vibration of the crystal. The beam of varying source of light thus created is focussed through a lens and onto the motion picture film when it is photographed as a variable light density.

The oscillating circuit to which the piezo crystal is electrically connected is made to vary by means of the microphone.

[1] U. S. Pat. No. 1,565,566, Dec. 15, 1925.



Diagrammatic outline of method of recording with the Piezo Crystal.

C. C. N. Y. Offers Course in Vacuum Tube Theory

ONE of the requisites for successful sound picture projection work is a thorough understanding of the theory and practical application of vacuum tubes to the work. In connection with this it is interesting to note that a course in the "Theory and Operation of Vacuum Tubes" is to be offered this semester at the College of the City of New York, in New York City. The course, which will be under the direction of E. Gordan Taylor, M.S., will run through 16 weeks. The class is strictly limited in number. The instructional work consists of two hours of lectures and discussion and one hour of laboratory work each week.

The course has been arranged particularly for those engaged in work involving a discharge of electricity through gases at moderate pressure as well as for those working with radio tubes or circuits utilizing high vacuum tubes. The greater part of the work will be devoted to a study of the operation and theory of the three-element type of tube.

Subjects to Be Treated

The first part of the course will be devoted to a brief review of a few of the fundamental physical laws of electricity and magnetism, after which the subject matter proper will be treated, including such subjects as: (1) General theory of ionization of gases; (2) Thermionic emission of filaments; (3) Vacuum tubes containing two or more electrodes; (4) Characteristic curves of different types of tubes; (5) Vacuum tubes as power or voltage amplifiers; (6) Rectification of alternating currents by means of vacuum tubes, and (7) Photo electric cells.

Those desiring further information on this course may consult Mr. Taylor in Room 107A by appointment. Fee for the course is $25.00. Students may register in person, or they may mail a check or money order for $25.50, including a library service fee, to Walter Staub, Bursar, College of the City of New York, 140th St. and Convent Ave., New York City.

New Color System

The Emil Busch Co. of Rathnow, Germany, recently demonstrated at the great Spanish exposition in Barcelona a new method of color motion pictures. This new method employs an optical system which splits up the image into two small

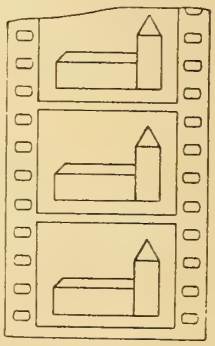


Fig. 1

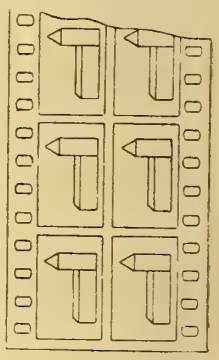


Fig. 2

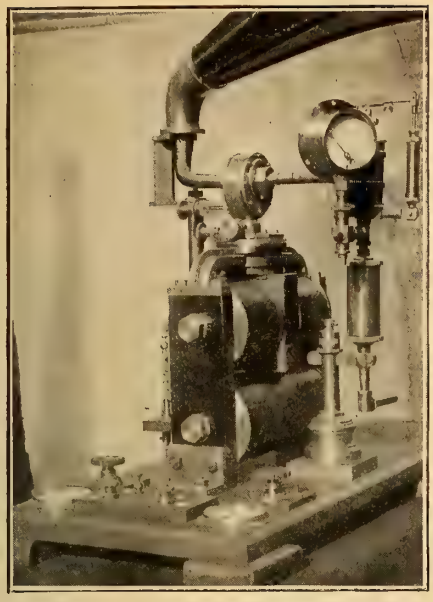
images, and so photographs them alongside each other on the same film. Two color filters—blue-green and orange-red—are used in the process.

When the positive is run through the projector these two color filters are used, and an optical system is also employed by means of which the two projected images appear as one on the screen. The demonstration of this process attracted a great deal of attention at the Barcelona exposition. Its sponsors state that the system will have the benefit of extensive promotion on the Continent.

In the accompanying illustrations, Figure 1 shows the conventional motion picture film with the figure thereon, as is the case with ordinary black and white; while Figure 2 shows the same image reduced and taken through the color filters.

Eugene A. Lauste

MANY readers have requested that we outline the work of Eugene A. Lauste, whose name continually crops up in discussions of development work in the



Lauste's compressed air loudspeaker, which was operated directly by a light sensitive cell without the aid of an intermediate amplifier.

sound picture art. Prior to his efforts in the recording and reproduction of sound, Lauste had many important contributions to motion picture technology in the form of projectors which at that time were examples of fine mechanical endeavor. Reference to the accompanying photograph of the Lauste projector will serve to convey to the reader the type of work done by Lauste.

It is in the sound picture field, however, that Lauste did his finest work. Lauste's British patent of 1906 was the first ever to be issued for a means of recording sound and scene simultaneously on film. It will be remembered that Ernst Ruhmer was the first actually to have disclosed a means for photographically recording sound and reproducing same by means of a light sensitive cell. Lauste used the "mechanical slit" for confining the variable light source in the "sound gate," as compared with the "optical slit" first used by Ruhmer.

Lauste's Film Loop

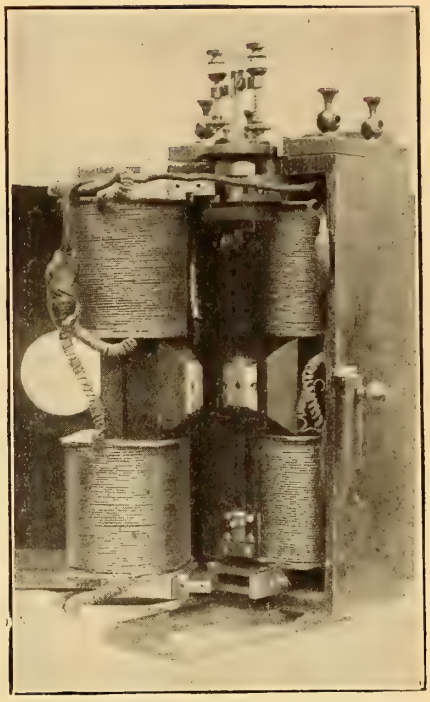
Lauste was born in France but emigrated to America at an early age. He entered the laboratory of Thomas A. Edison where he was assigned to motion picture work. Here he designed many mechanical movements for intermittently advancing the film. To him belongs the credit for the loop in the camera and projector. Lauste was the first to demonstrate motion pictures at the Vatican in Rome.

It is interesting to note that it was Lauste's testimony which influenced the court to issue the now famous order which dissolved the vicious patent combine which for a time early in this century threatened to destroy American development of motion pictures.

The records show that Lauste was active in sound picture work as far back as 1896, when he began his experiments to photograph both sound and scene simultaneously on film. It was not until 1906 that a patent covering the means for successfully accomplishing this work was granted to him.

Use of Diode Tube

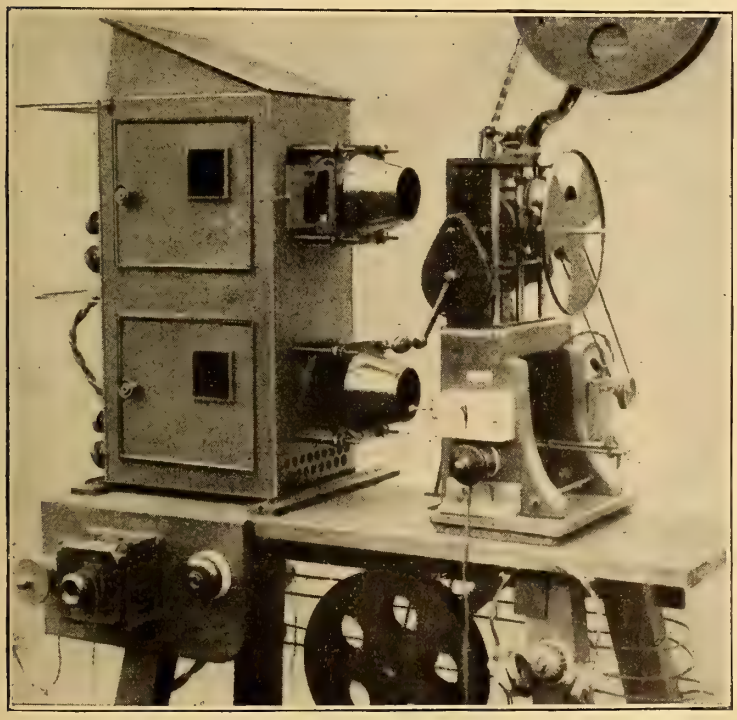
Lauste made use of every then known physical means for recording sound. Among the methods employed by him were manomatric flame, oscillating arc, shutters, mirrors, gas-filled tubes, and string galvanometers. By means of this latter device he became the first to actually record sound



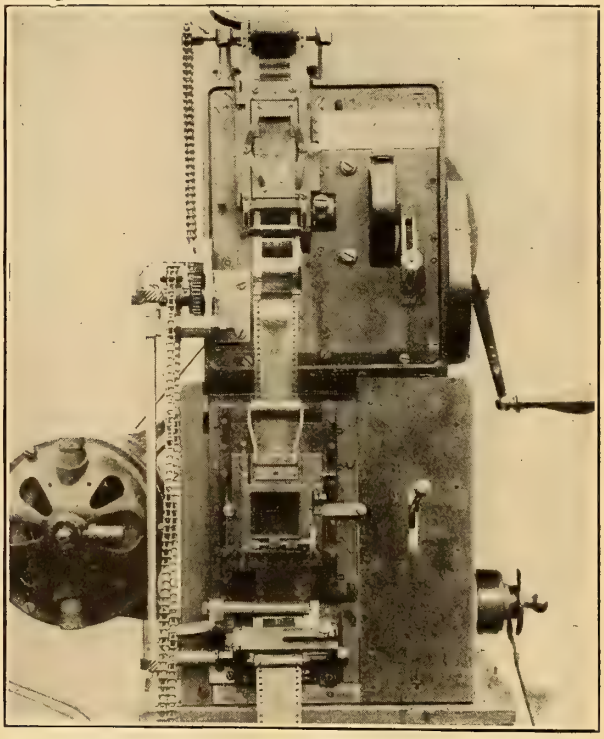
"String" galvanometer used in making the "saw tooth" sound film record.

by what is now known as the "saw tooth" method.

If one were to read carefully the 1906 British patent granted to Lauste, one would note on page 5 therein reference to the use of an "electric lamp in connection with the loudspeaker as a means for amplifying." No details are given as to this "amplifying lamp," but the writer feels reasonably sure that it was a "diode" tube (two-element, i.e., a hot filament and plate), similar to the rectifier tubes now in com-



Showing the projector head assembly made by Lauste. The top lamp is for the film, while the lower lamp is for the sound gate proper. Used by Lauste for public demonstrations in 1912.



Back view of the Lauste projector. Film gate on top; the sound gate at bottom is in the form of an adjustable slit, for experimental work.

mon use. This diode tube was in common use by radio experimenters prior to 1906.

For some reason unknown to the writer, this means of amplifying was subsequently dropped by Lauste in favor of the compressed air loudspeaker. This latter consisted of an air compressor, air storage tank, and electrically-controlled valve. This valve was connected in series with a potential and a light sensitive cell (selenium). The valve varied the compressed air, and successfully produced sound which could be heard for a distance of four or five city streets. A similar compressed air loudspeaker was manufactured by the Victor Talking Machine Co. and was sold under the trade name of the "Auxetophone."

Lauste's Contributions

It cannot be rightly denied that it was Lauste who made the first successful sound pictures. It is a matter of regret that the many improvements made since Lauste's time were not made just a little earlier so that the fruits of this brilliant investigator's work might have been reaped by him. As it was, Lauste merely smoothed out the road of those who followed him, as is so very often the case with pioneers in any field of endeavor.

Projectionists will find much of interest to them in the work of Eugene A. Lauste, for it was he who made some of the most important contributions to the development of the motion picture projector. The proof of Lauste's fine mechanical talents is contained in the accompanying illustrations which show conclusively that this man certainly was far ahead of any of his contemporaries.

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Photo Electric Cell Fatigue

Recent comments in technical papers anent the "fatigue" and "lag" characteristics of photo electric cells prompted the invitation to the following workers in the art for their opinions on the subject. We are told, among other things, that cells must not be exposed to light when not in use and that certain cells display a definite "lag" characteristic. Both characteristics are discussed in the following interesting comments.—The Editor.

A. J. McMASTER,
G-M Laboratories,
Chicago, Illinois:—

THE interesting question as to whether photo electric cells of the alkali metal type are subject to depreciation when not in use, and particularly when such cells are exposed to light, has been discussed pro and con for a number of years. Some cells do show depreciation of this sort, although in a final analysis it is generally found that the loss of sensitivity is not due to exposure to light but is inherent in the particular cell in question.

In normal operation, exposure to light produces emission of electrons from the sensitive surface of the cell, which negative charges are replaced by the source of potential connected in the external circuit of the cell. When the battery is omitted or the circuit is open, electronic emission occurs upon exposure to light, but a state of equilibrium is almost instantaneously reached which inhibits further discharge of negative electricity.

Although it is the writer's opinion that no deleterious effects are produced by exposure of a high quality photo electric cell to light when the cell is not in use, it is highly recommended that cells of the alkali metal type not be exposed to strong direct sunlight or intense incandescent sources at close range, due to the marked depreciation caused by the heating of the cell.

As the materials used in some types of cells have a very low melting point, the effect of even moderate heat is to practically destroy the usefulness of the device.

As mentioned above, some cells show rapid depreciation with time whether in light or in darkness. This effect is due to the chemical action within the cell as a result of improper preparation of materials. Undoubtedly the purity of materials used and the amount of care exercised in evacuating the envelope are of primary importance in the manufacture of a quality product of this kind.

The subject "fatigue" has many ramifications and a long story could be written about the same without perhaps convincing anyone of the truth of the matter. However, I believe that your editorial policy in this regard will bring to light interesting information of considerable value to your readers.

DONALD H. LOUGHRIDGE,
R. C. Burt Laboratories,
Pasadena, California:—

I agree thoroughly with the recent statement of Samuel Wein in your columns to the effect that a great deal of this talk in regard to the necessity of keeping photo electric cells in the dark is mostly fundamentalism.

Our experience with various types of cells has shown that in the modern type of cell fatigue is practically absent, and exposure even to bright sunlight for as long as eight hours with maximum current being taken from the cell at all times shows absolutely no change in the sensitivity of the cell.

SAMUEL WEIN,
Radiovision Corp.,
New York City:—

Among the comments on photo electric cells which you submitted to me are the following: (1) photo electric cells, if exposed to a strong source of illumination, are subject to fatigue and require some little time period before they are fit for further use, and (2) it requires several minutes after certain cells are connected to a source of potential for them to function properly. That both comments have no basis in fact will be shown presently.

Before we go into the subject matter proper, it would be best if we have a definition of terms.

Fatigue: Webster's Dictionary tells us that it is a "state of exhaustion" or "tired."

Lag: The same source tells us that this is to "move slowly" and also to "stay behind."

Let us now see what bearing these definitions have on the photo electric effect. Fatigue as applied to *photo electrons* would be a gradual decrease in the photo electric *emission* with the same source of light. Whereas, lag would be an inertia of the cell in responding to a light change. Let us see if it is possible to give a practical analogy to these effects.

When a battery is in continual use, its output continuously decreases: this would correspond to *fatigue*. On the other hand, if a potential is applied to a motor, the latter will require a few seconds for its armature to reach uniform and maximum speed: this corresponds to *lag*. As a matter of fact, if the potential applied to a motor is switched on and off several times in quick succession, the motor itself will not respond to these "on and off" periods of potential.

Thus we see that there is a marked difference between "fatigue" and "lag," although both these terms are loosely applied by some writers.

As a matter of fact, the true photo electric effect will exhibit no lag or fatigue characteristics. However, if a cell does show these characteristics, it will be because of (1) the absorption of *occluded gases* of the alkali metal or its corresponding hydride, forming, as it does, a chemical reaction, i.e., an "oxide," (2) a gradual or slow seeping of air into the cell (3) a gradual change of the alkali metal surface, and (4) the most probable cause, a faulty amplifier to which the output of the cell is connected.

Much of the difficulty experienced with photo electric cells may be traced directly to the "grid resistor" connected in series with the cell and directly across the "grid" of the first amplifier tube. This resistor is very unstable and not only varies its characteristics with the temperature of the room but also with the humidity and the amount of current flowing through it. On the other hand, if a transformer-coupling is used with the cell, this grid resistor difficulty is overcome. One company uses a high resistance unit in series with the photo electric cell and transformer as a means for protecting the cell from over-loading.

Another difficulty experienced with photo electric cell amplification is "current leakage" across the base of the cell. This is sometimes attributed to the cell proper, but it is known that this leakage may be eliminated by taking the leads out of the cell at opposite ends, such as is now done by certain manufacturers.

The conclusions to be drawn from the foregoing are that the photo electric cell possesses no inertia or lag and hardly enough fatigue to be noticeable. Such difficulties as have developed are the fault of the apparatus used with the cell.

THE SEILER EXPERIMENT:—

Miss Seiler[1], a student of Professor Kunz at the University of Illinois, undertook to ascertain whether a long period of "illumination" of a "hard vacuum" or "hydride" cell would give rise to fatigue. To do this

[1] Astrophys. Jour. Vol. 52, p. 129, 1920.

she tested certain cells for a period of more than 1,000 hours, during which time she observed at regular intervals the galvanometer deflections, the while keeping the temperature, intensity of light, and the source of potential (110 volts), constant at all times.

After 520 hours' exposure to a strong source of light the cell had increased in sensitiveness by a considerable degree. The galvanometer deflections began with 176 mm. and gradually increased to 300 mm. at the end of the exposure period. The potassium hydride cell, on the other hand, under the same conditions excepting that the applied voltage was 36, showed no exceptional constancy. Slight fluctuations occurred during the exposures, the initial and final galvanometer readings were 194 mm. and 191 mm., respectively, showing that fatigue was negligible.

These same two cells were exposed for 60 hours without continuously applying a voltage. At the time the photo electric galvanometer deflections were taken, 110 volts was applied to the potassium cell and 27 volts to the potassium hydride cell. All conditions remained constant throughout the experiment.

The results showed an increase in sensitiveness for both cells, the initial and final deflections for the potassium hydride cell being 196 mm. and 316 mm. It seems strange that the mere exposure to light, without the passage of a photo electric current, should increase the sensitiveness so much more rapidly than when the applied voltage caused a current flow through the cells. Both investigations, however, point to a negative conclusion with regard to a fatigue effect.

New Film Patches

THAT motion picture projection is undergoing a refining process constantly even in the smallest details is evident by the many suggestions for improvement in such an item, for example, as film patches. Film patches in themselves are very important, as every projectionist knows, yet the fact that in this stage of motion picture development—what with sound film, color, and third dimension being the salient features of creative work—it is interesting to note that other phases of motion picture technique are not being neglected.

An improperly made film patch is the cause of many breaks in a show, interruptions which are costly to all branches of the industry. It really seems as if there is nothing as irritating as to have an interesting motion picture suddenly terminated. The film patch is often the reason for this.

What follows will demonstrate that the film patch is anything but insignificant in the scheme of things projection. Many projectionists, with years of experience, have come to regard film patches as a mere detail of their daily routine. And so they are, but carelessness in this detail is inexcusable—particularly so for the experienced projectionist.

Causes of Film Tearing

A few words anent the causes of film tearing will not be amiss at this time. Summed up, these causes are as follows:

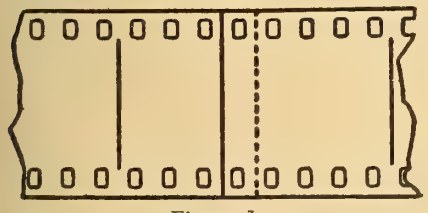


Figure 1

(1) Brittle film, due to a dried condition (2) Continuous wear on the film by mechanical parts (3) Abuse of film in handling, such as too rapid rewinding and (4) Opening of a poorly made patch.

We shall not concern ourselves at present with the causes of film tearing other than to offer the above summary, but we shall discuss the manner of making correct splices and shall offer details on methods recently outlined for improving this important detail.

In Figure 1 is seen the common type of patch, well-known to all projectionists. It is made by cutting both ends of the film and disposing of the emulsion by moistening and removing it with a razor blade or some other sharp instrument. The film cement is thereafter applied to both ends, which are then brought together and subjected to pressure for a few seconds. Proper sprocket hole alignment is essential in this operation.

New-Type Patches

Lyman[1] in Figures 2 and 3 shows a new method for splicing. The film is cut

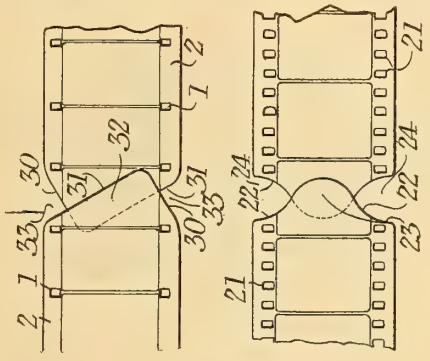


Figure 2

to form a tapered end bluntly rounded to form an apex. The extent of the overlap is less than the complete tapered portion. There is thus left at each end of the film

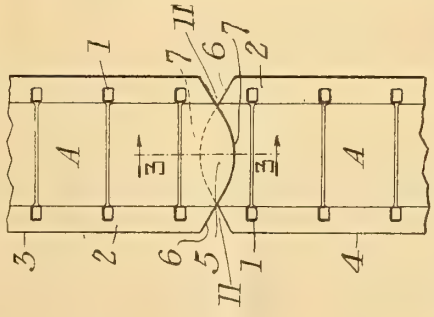


Figure 3

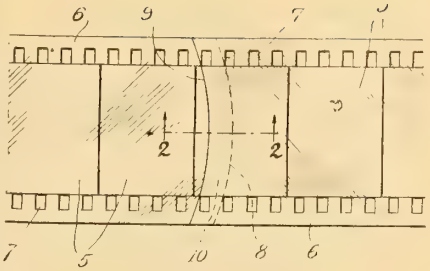


Figure 4

a notch opposite the patch. The length of the notch is less than that of a picture area or of the distance between successive perforations. Other forms of patches make use of a piece of celluloid holding together two ends of film, with a space between the perforations.

McLaughlin and Swing[2] show their method of forming a patch in Figure 4. The two ends of the film are cut so as to give it a concave edge, as at 9 in the drawing, on the edge of the film. This presents a curved seam, 10, of no greater width than is usual but obviously having an increased superficial area. The radius of the cut edges, 8 and 9, will ordinarily be the same, but this radius may be varied as preferred from that shown, in which the length of the radius is substantially equal to the length of the chord. This presents a central extending tab portion as the film is advanced in one direction and opposed elements at the ends of the edge, 9, when moved in an opposite direction.

Experiments have demonstrated that a lapped joint made in this manner is appreciably stronger and less liable to separate than a patch in which the edges are cut squarely across.

REFERENCES

[1] U. S. Patent No. 1,727,349, Sept. 10, 1929.
[2] U. S. Patent No. 1,728,974, Sept. 24, 1929.

Paper Sound Track Patch

A reader, Mr. A. Caminetsky, of Brooklyn, N. Y. recommends the pasting of a gummed piece of paper of a size exactly the same as the recommended sound film patch over the patched portion of the sound track. It is claimed by him that with the black Movietone lacquer there is a slight click audible in the horns as the splice passes through the sound gate. Mr. Caminetsky is right in this contention, but we hardly can see where his suggested method offers any improvement.

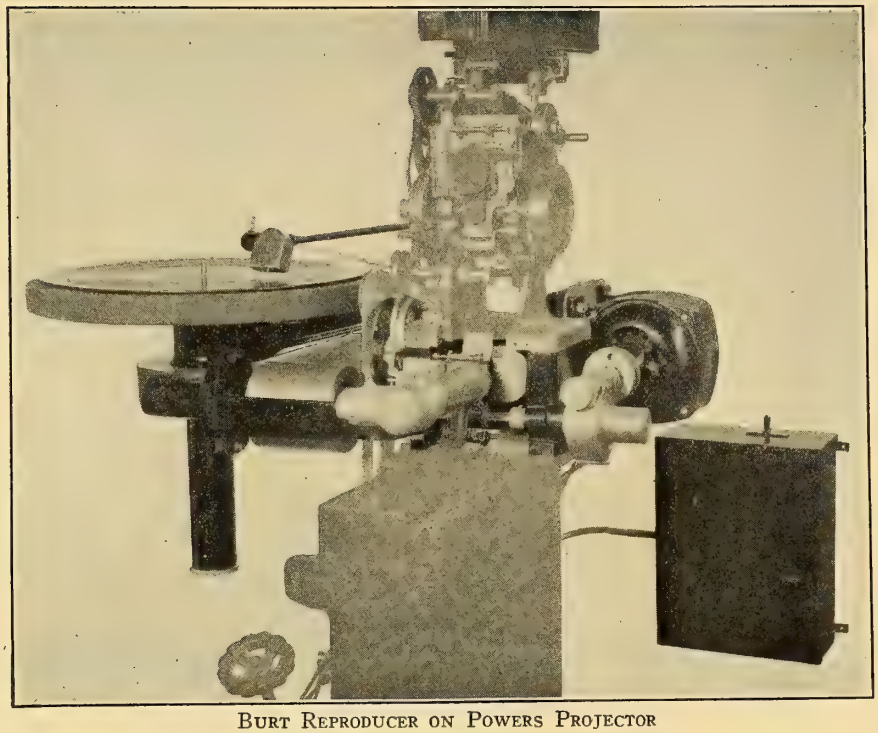
Danger of Lint

Gummed paper such as is suggested by Mr. Caminetsky is likely to peel when subjected to heat, or lint from the paper is very likely to clog the film gate. Although it is denied that the paper, once tightly applied to the film, will either peel or give off lint, the practice is too fraught with possible serious consequences to merit a recommendation.

Mr. Caminetsky's suggestion is centered about the fact that the noise occasioned by the paper-covered splice as it passes through the sound gate is below 15 cycles and thus below the threshold of audibility.

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TURN TABLE IS ACCESSIBLE, being up high at the side of the machine.

EASY TO INSTALL. Installation can be made by the ordinary operator, and wire man.

PROJECTOR HEAD is driven by its main drive gear and is not required to drive any part of the sound equipment.

ONLY THREE SHAFTS: (1) Motor Drive Shaft, (2) Sound Film Shaft, (3) Disk Table Shaft.

VARIABLE SPEED can be used for making schedule by driving the head off the Powers Motor, when running silent. Change from synchronous drive to variable speed drive requires about ten seconds.

NO UNIVERSALS—No flexible couplings, flexible shafts, or long unsupported shafts are used, as these produce tremolo.

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Television—Present and Future

(*Continued from page* 19)

can be done where a number of channels are available, as in telephone practice. The total frequency can be separated into a number of frequency ranges and those of the higher frequencies transmitted as lower harmonics to get them into the frequency range of the present wire channels. Thus, there may be used 8 or 10 pair of wires to handle the different frequency ranges that are again assembled at the receiver. It might be said that the progress of television depends upon improvements in means for handling the signals between the transmitter and the receiver.

No mention has yet been made of amplification, but this phase of television work follows general radio and sound picture practices. At the receiving end there will be banks of amplifiers not only for the picture signals but for the sound as well. The sound will be fed into apparatus similar to that in use today and thence into the horns.

Reproducing Process

Reproducing the picture presents, however, quite a problem, both mechanically and electrically, for to be of any practical commercial value, the picture must be as large as that at present shown on the regular motion picture screen. Although the apparatus may finally take the form of a projector, it is not unlikely that the early machines will be designed after the fashion of the tube screen employed by Bell Telephone Laboratories in their television tests of 1927.

The Bell Laboratories apparatus consisted of a long Neon tube which folded back on itself to form a square screen as suggested in Figure 3. For our purpose this screen would have to be as large as the present motion picture screen and consist of about 960 separate tubes almost touching each other. An electrode consisting of a wire spiral runs through each tube which is filled with neon or another gas which will cause a glow when a high voltage current is applied to it. On the back of each tube are glued pieces of tinfoil, it requiring about 960 pieces along each tube with each piece insulated from the next. The wiring of this frame would be rather complicated to show in detail, so its operation will be explained with the help of Figure 3.

For the sake of clarity, let us assume that the incoming television signals have been amplified and the output of the amplifier connected to the arm *A* of the row of segments shown connected to the tinfoil strips. The voltages have been adjusted so that the tube at any point will glow at a brilliancy equal to the light value of the spot which is before the photo electric cell at the transmitter. Then if the arm *A* is on the contact connected to the upper left-hand tinfoil, a light will be produced at that point equal to the light falling on the photo electric cell when the scanning disc has just started across the picture.

Now consider the contact arm at the receiver moving in perfect synchronism

Electrical Energy

The power that is transmitted by any electric circuit depends on the current and the voltage. The unit, the watt, is the amount of power obtained from one ampere at one volt. This unit is too small for ordinary purposes and the kilowatt equal to 1000 watts is used.

For D. C. circuits:

$$W = I \times E$$

W = Power in watts

I = Current in amperes

E = Electromotive force in volts

In A. C. circuits the entire current is not always available for doing work. This calls for another term in the energy equation, the power factor, which is the ratio of the current available for power to the total current. For single-phase A. C. circuits the equation becomes

$$W = I \times E \times P$$

P = Power factor of the circuit

For two-phase A. C.

$$W = 2 \times I \times E \times P$$

For three-phase A. C.

$$W = 1.73 \times I \times E \times P$$

Electrical and Mechanical Conversion Factors

1 H.P. = 746 watts = .746 kw.

1 kw. = 1.344 H.P. = approx. 1⅓ H.P.

with the disk at the transmitter. As the light falling on the photo electric cell varies as the disc moves across the first strip, we will have light variations along the tube that are of the same intensity. As the second hole at the transmitter starts across the picture, the contact arm at the receiver is contacting with the second tube and again the light values are reproduced just as picked up at the transmitter.

Wire Television First

This action continues until the whole scene is built up and a complete picture is shown. The whole picture is shown 20 times a second, thus the eye, as in present-day motion pictures, gets the effect of a continual picture. This rather brief sketch is but a presentation of the basic principles of television, and we shall not tarry to figure out how many contacts the commutator must have. The answer would be 921,000.

A television system demands perfect synchronism, for the contact arm and disc must keep in step or the picture will shift. With wire transmission it is entirely possible to accomplish this, and the technicalities of the methods available will be presented in an early issue of this publication.

Thus are the chances of television, considered in the light of present practice. It has been said that seventh-grade arithmetic is enough to prove television impossible; but, after all, mathematics may be made to prove almost anything one wants it to prove. It may take years for the development of a *radio televison*, but *wire television* will be an accomplished fact before the echoes of "It can't be done" die out.

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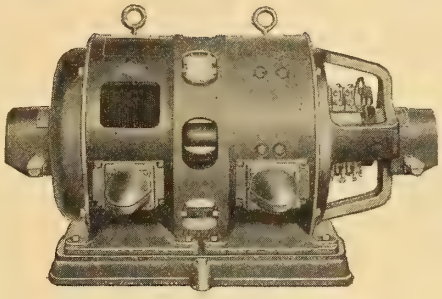
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Color Process

(*Continued from page* 25)

reconstructed by presenting each transparency with its proper filter in a viewing instrument. This may be done by projection with the use of a triple lantern, in which case the red, green and blue transparencies will be projected simultaneously from the lantern forming one picture in natural color on the screen. This process of color photography reached its highest development in the hands of Mr. F. E. Ives, whose Kromscope has never been surpassed for absolute fidelity in color photography.

The triple lantern is wasteful of light, and there are other defects in the additive process which make it somewhat unsatisfactory commercially. The subtractive process is a more commercial method and is much more widely used. In subtractive processes the three negatives through the red, green, and blue filters are taken as in the additive process but they are printed to be used as superimposed prints, each print being made in a color which is complementary to the taking filter.

The Subtractive Process

Let us consider our discussion of the subtractive process as confined to still photography in the making of prints. When we print from the red sensation negative we are printing from the thinner parts of those parts which represent the absence of red in the subject, hence the red sensation negative must be printed not in red but in a color which completely absorbs all red. In other words, the red negative is printed in its complementary color—that is, blue-green. The green negative, therefore, will be printed as magenta, and the blue negative as yellow.

Superimposed in full strength these colors absorb all color, and the result is either black or gray, according to the amount of light reflected. Intermediate colors are produced by the mixture in various proportions of the three fundamental colors; while the total absence of color will produce white, provided we are printing, for example, on white paper or if we are printing a transparency to be viewed by white light. It will be observed that in this case we start with white light from which we produce color by subtracting various colors, hence the name "subtractive process."

How Processes Differ

These two processes may be differentiated one from the other very simply as follows: The additive process is one in which we start with colored light from which we produce white; while the subtractive process in one in which we start with white light and from which we produce colors by subtracting various colors.

The present-day commercial processes are most generally based upon the subtractive principle and it is quite probable that those processes which will be most successful commercially, from the motion picture viewpoint, will be those making use of this principle.

Care and Maintenance of Motors and Generators

SYSTEMATIC inspection at least once a week is necessary to insure the best operation of motors and generators and the following points should be given special attention and consideration.

Both the interior and exterior of machines should be kept free from water, oil, dirt and grease. For machines installed in very dirty places, troubles may be averted by periodically removing the rotor or armature and thoroughly cleaning the machine.

Cleanliness

A vacuum cleaner is highly recommended for cleaning assembled machines. The use of compressed air is not recommended on assembled alternating current motors. It is especially objectionable on machines installed in locations where there is much carbon dust, metallic chips, etc., as the compressed air may drive the dirt or metallic chips into the windings and cause break-downs. On direct current machines the use of compressed air is not objectionable because all the parts are more or less accessible, especially the commutator and brushes.

Lubrication

Bearings—The life of bearings is affected by the lubrication, belt tension and alignment of the driving and driven shafts. Excessive wear and heating of all bearings can be reduced to a minimum by adequate lubrication, proper belt tension and accurate alignment. When bearings are unduly worn, they should be replaced, and after the new bearings have been put in, the air gap should be tested to see that it is uniform all around.

Oil wells should be filled with petroleum oil (not vegetable or animal oil) through the oil filters, while the machine is at standstill, up to within 1/16 in. of the top of the oil filler. Experience has shown that animal or vegetable oils or greases, or admixtures of them with mineral or petroleum oil will dry and gum, and by gumming ducts and oil rings, prevent the free flow of oil to the bearings.

Incorrect oil level may be experienced if the oil wells are filled while the motor is running. After a motor has operated for the first week, the oil should be drawn off and the bearings washed out with kerosene, to wash out all sediment before refilling the bearings with oil. The drainage plugs should be taken out and dipped in a mixture of red lead and shellac and then replaced and tightened securely to prevent leakage.

The bearings should be refilled at regular intervals, the frequency depending upon local conditions, such as cleanliness, severity or continuity of service, etc. After changing the oil, the oil rings should always be inspected to make sure that they are in their proper position and turn freely.

Brushes

Tension—The brushes should be inspected to see that they move freely in the holders and at the same time make firm, even contact with the commutator.

(*Continued on page* 48)



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Auditorium Acoustics

By S. BAGNO

II

THE simplest yet most reliable test for reverberation is to clap the hands smartly together, and then to note the time for the sound to die down completely. This is a rough approximation of the reverberant period of any orifice; it will also enable the hearer to find the most pronounced source of echo. The use of a piano enables one to test for many frequencies, and will give a fair idea of the acoustical characteristics of a theatre for the entire musical scale.

The effect of reverberation is different for speech and music. Whereas speech becomes less intelligible with increasing reverberation, music is given an impression of depth that is entirely lacking out in the open air. The average reverberation period for a music hall should be about 25 per cent. greater than for one designed entirely for speech.

Resonance

Another problem is that of resonance. Resonance is a forced vibration of any section of the orifice, due to the fact that it is tuned exactly to the same frequency as the source of sound. Not only the air in a theatre may cause it to act as a large organ pipe, but the walls, woodwork and ceiling may act as a large selective sounding board. When this occurs, certain notes may be so much amplified above the rest of the sound as to be jarring to one's nerves, and certain overtones in speech may become so loud as to make the rest of the harmonics seem badly distorted.

This destroys the original quality of the speech. Often, when the second harmonic of the voice is unduly amplified, a rich baritone sounds like a piping soprano. More often, the fundamental is magnified and the voice sounds like a low-pitched growl.

Resonance may be detected in several ways. Perhaps the easiest way is by whistling; although the usual practice is to have someone sing up and down the musical scale to detect whether the thea-

Equipment Troubles and Maintenance

(*Continued from page* 28)

fader binding posts. This point is the electrical center of the first half of the system. If sound is heard at this point, then we may safely assume that the trouble is in the control section of the system.

When listening at the output of the amplifiers with a headset, it is well to remember that a headset should not be worn on the head, as the volume at this point is sufficient to occasion serious damage to the ear drums. Care should also be taken not to get one's fingers across the binding posts at this point, as the voltage is quite high and may give one a serious shock.

A majority of "no sound" troubles may be traced to some small detail of the system, such as a pulled plug, dirty contact or loose connection. In succeeding issues we shall discuss each section of the equipment in detail with regard to trouble shooting.

A Warning and Some Good Advice

Editorial from
EXHIBITORS HERALD WORLD
Of May 4, 1929.

TECHNICAL ADVICE.

When an exhibitor sets out to obtain advice and guidance on the selection of sound reproducing equipment for his theatre he should bear well in mind that the problem at hand is not a theatrical one, not an ordinary matter of showmanship and not a question of a type which a lifetime about a theatre would necessarily qualify a person to pronounce upon.

The selection of sound reproducing equipment for a theatre involves some very exact technical questions and the advice and guidance of a competent technician is not only desirable but absolutely essential.



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tre reenforces any note or notes. This reenforcement will repeat itself for several octaves, as the body, or air column, vibrates in sections. The lowest pitch to which it responds is the natural frequency of the resonant body.

The presence of resonance in a small quantity is desirable, because it tends to strengthen the original sound. Resonance is usually eliminated by damping the vibrating body. This is accomplished by putting a soft, pliable substance, such as cloth, against it. When an air column is vibrating in resonance, it may be damped by covering its walls with sound absorbing materials.

Interference

Like resonance, interference will affect only certain components—the components that are also affected by the resonance of the air column in the theatre itself. This condition is most evident in rectangular-shaped theatres. The property of interference consists in the sound reenforcing itself in one portion of a theatre with the reflected vibrations from the walls, and opposing each other in other parts of a theatre. This point may be illustrated by the waving of one end of a rope the other end of which is tied down. If the motion of the hand corresponds to the natural frequency of the rope, the entire rope will bob up and down. If, now, the frequency of the rope be doubled, the rope will vibrate in two sections, while the middle of the rope will appear to be still. Here we have reenforcement and interference. The vibrating sections of the rope may be considered the reenforcement sections, and the middle may be considered the reenforcement section.

This is almost a perfect analogy to the condition encountered in any air column as the waves are reflected from the walls and add to and interfere with the waves coming to the wall. Interference at high frequencies is negligible because the human ears, because of their distance apart, tend to balance out their effect. Although interference may be quite marked at lower frequencies, it may also be discounted because it does not interfere with our perception of the intelligence of sound.

When interference becomes too marked, as sometimes happens when the reflections from the roof interfere with the sound coming to the theatre balconies, it usually may be eliminated by padding the reflecting medium, or by keeping the sound off the ceiling by specially shaped baffles of horns, such as are used by RCA Photophone and Western Electric.

Focusing

Another acoustical defect which gives the impression of sound coming from a direction other than the screen, and which often causes many in the audience to keep turning their heads to locate the source of the sound, is focusing. Sound, like light, can be reflected and focused from its source to any other point in a theatre. A circular dome has the same effect on sound as has a concave mirror on light:—it concentrates it to one point. To the audience such a condition will give rise to the impression that the sound is coming directly from the dome.

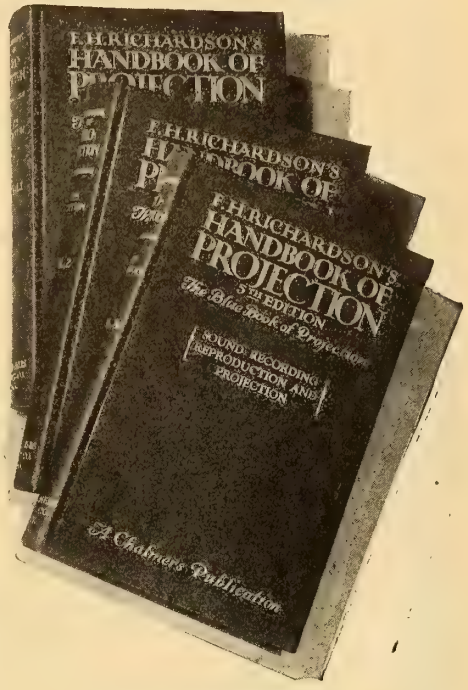
The only method which has been found to work to advantage in correcting this condition is to keep the source of the sound shielded from such a dome by the same means as were described in overcoming interference—directional baffles. These baffles come very near eliminating all troubles from this source.

The proper time to consider the acoustical character of any auditorium is at the time of the initial design. Technicians may not appreciate the fact that a large portion of the theatre-going public are aware of whether a theatre has good acoustics or not, but it is a fact nevertheless.

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Sound Projection Hints

By R. H. McCullough
Fox West Coast Theatres

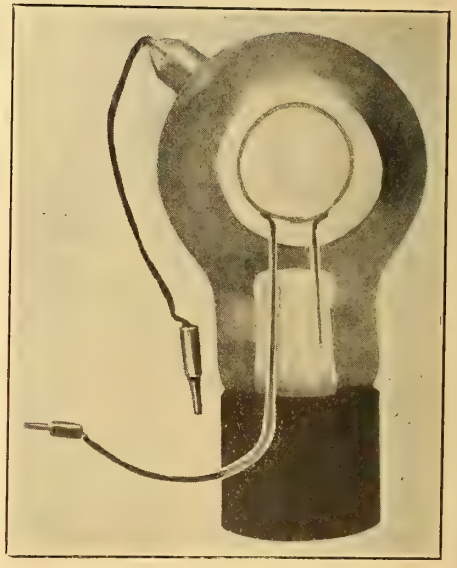
THE Western Electric photo electric cell amplifier cradle should always swing freely. The rubber base has a tendency to swell, pushing the amplifier upwards and causing it to touch the housing. If such is the case, the rubber should be replaced to avoid mechanical noise in the pick-up. Inspect the cradle swing supports and see that they are of proper length.

It is imperative that the Movietone light gate be cleaned before threading the projector for sound film presentation. All projector bases should be permanently grounded. Do not allow any outside source of light to come in contact with the photo electric cell compartment during the time the film attachment is in operation, other than that which comes from the exciter lamp. Avoid placing microphonic tubes in the first socket of the photo electric cell amplifier.

A hum will be perceptible if the sprocket perforations project over in the sound aperture. Keep sprockets and idlers clean at all times. Before starting the projector, observe the meter readings and set at normal operating values. The projectionist is entirely responsible for efficient operation of his equipment, thus a thorough check should be made of all units prior to running the show.

Photo Electric Cell

The photo electric cell consists of a glass bulb having two lead wires or connections. The inner surface has a coating of silver covered with light sensitive material of metal potassium. The negative or cathode lead is connected to this surface.

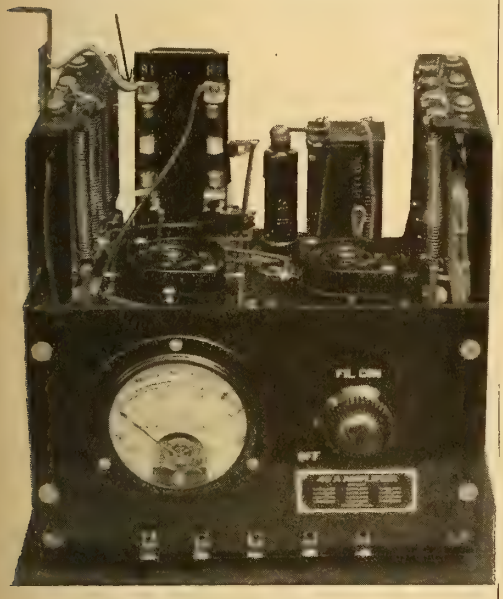


1-A PHOTO ELECTRIC CELL

Note the cathode lead, which is attached to the inner surface of the cell. Also note the anode lead, which is connected to the ring-shaped conductor inside of the cell

An opening is left on one side of the bulb, which serves as a window for the light to enter. A ring-shaped conductor is connected to the anode or positive lead.

When the light sensitive material is not subjected to light, the argon gas acts as a non-conductor. When light passes through the film and reaches the sensitive surface of the bulb, electrons are set free and are directed toward the anode by the potential applied to the cell; due to this action, the argon gas becomes ionized and therefore becomes a conductor. The amount of light entering the cell controls the current similar to the valve which controls water



49-A AMPLIFIER

Arrow points to positive P. E. cell lead. Note how amplifier is supported by suspended springs for the purpose of absorbing vibrations caused by projector working parts. This constant swinging cause P. E. cell lead to break loose from connection.

flowing through a pipe. The photo electric cell is connected to the first stage of amplification.

Crackling Noise

From the photo electric cell positive terminal to the grid leak clip on the amplifier there is a very small stranded wire. The constant vibration of the projector causes the amplifier to swing. This swinging causes the strands to break in the soldered connections, but leaving enough contact to make connection: thus, as the amplifier swings a crackling noise will be perceptible. Inspect these connections very closely.

Crackling noise is often caused by the 1 ampere midget fuse in the photo electric cell "B" battery box being defective. PEC "B" battery connections must be soldered. All tube prongs must be properly inserted in their sockets. Frequently inspect all connections and make sure that they have not worked loose.

The Battery Charger

This is a device used for furnishing direct or pulsating undirectional current to a storage battery for the purpose of recharging. The battery charger is like a pump and the battery is like a tank. The battery charger must be capable of maintaining a charging rate sufficient to keep the battery fully charged.

There are three principal types of alternating current battery charges in use:—the bulb type, the electrolytic type, and the vibrating type. Reference to the bulb type is made here because of its present use for recharging storage batteries used in connection with sound equipment. The bulb type charger consists of a transformer connected to the supply line and a rectifying bulb of the argon type. The tungar bulb consists of a coiled filament of wire and a plate a little distance away from the wire filament. The filament is made of tungsten and the plate is made of graphite. The air is drawn out of these bulbs and they are filled with very pure argon gas. In all cases the plate of the rectifiying bulb is connected to the negative side of the battery to be charged, while the positive is connected to tube filament through the transformer winding.

It is extremely important that storage batteries be not overcharged. Calculate the battery charging rate. Add the number of amperes drawn by all the tubes in the amplifiers, with filaments or plates drawing current. Multiply the amperes by the number of hours of use and then add one-quarter to this amount (to make

(*Continued on next page*)

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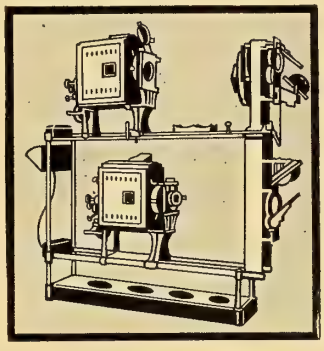
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Advances Made in Color Photography

ADVANCES in the art of color photography and projection are cited in the following excerpt from the report of the Progress Committee of the S.M.P.E. as read at the Spring meeting held last May in New York City. It is apparent from this report that the majority of serious research work in this field is being done by foreign experimenters who have made many important contributions to the art. The report follows:

Color Cinematography

There have been no outstanding advances recorded in the field of professional color motion pictures. Lehmann and Kofes in a long general article have reviewed the possibilities of two-color photography and have concluded that a two-color subtractive process is in general more satisfactory. The method of manufacture of Lognose color, screen film has been described by Emmerman. Patents related to three-color cinematography are in general concerned with methods of making multi-color screens, successive exposure through primary filters, and exposing through prisms to three images on the area normally occupied by one picture.

A short description has been published of the working principles of Keller-Dorian color films, on the support side of which horizontal cylinderical lenses of 1-60 mm. are embossed. Exposure is made through a three-color diaphragm, the film being threaded in the camera with emulsion side away from the lens. Patent protection has been granted for a number of improvements in the processes using embossed films.

Wolff-Heide Process

Bourquin has given a description of the Wolff-Heide two-color additive process. Pictures are taken with an ordinary motion picture camera at 28 frames per second, using film which has alternate frames sensitive to red and blue, respectively. Alternate frames of the print are dyed and the film projected at 24 frames per second. A few patents of interest pertaining to two-color additive methods have been issued.

The changed patterns produced by a suitable grouping of colored elements moving slowly past the end of a kaleidoscopic prism have been reproduced by Jones and Tuttle, using a two-color subtractive process. The

Sound Projection Hints

(Continued from preceding page)

up for battery efficiency). The result is divided by the number of amperes given by the charger. The division shows how many hours the charger should be operated for the number of hours the amplifiers are in use.

Salvaging Battery Charger Bulbs

I have found that many projectionists are discarding quite a few tungar bulbs, because they are thought to be burned out, when such is really not the case. Frequently the base of the tube makes an imperfect contact in the socket and this causes arcing, with the result that in a short time the bulb ceases to function and goes out. Check each tungar bulb before discarding. Be positively sure that the bulb and socket contacts are clean and free from corrosion, before concluding that the tungar bulb is dead.

use of such color film for embellishment of theatre programs is suggested.

Mudrovic has conducted an investigation on sensitizers and dyers suitable for use in the bleach-out process whereby film is coated with a mixture of three primary color dyes which bleach out in direct proportion to the amount and color of the exposure light reaching them during the exposure.

A chemical process cell Pathechrome has been announced to replace the old stencil process of Pathecolor.

Subtractive color processes for which patents have been issued recently are related to imbibition printing, apparatus for exact registering of two films, production of double-width, double-coated film for recording two pairs of images in four colors, etc.

Amateur Color Cinematography

An additive process of three-color cinematography using 16 mm. film was announced in August, 1928. A three-color filter is used on both the standard camera and projector and a series of tiny cylindrical lenses are embossed vertically on the film support. The film is threaded in the camera with the emulsion side away from the lens so that the light passes through the embossed lenses before it reaches the emulsion. Each minute lens element images the three color filter diaphragm and thus exposes one, two or three lines on the film according as the subject reflects one, two, or all three primary colors.

On projection, the lens elements and the filters serve to recombine the colors of the original subject. The film is developed by a reversal process.

In another new amateur color process, alternate color records are exposed on a film moving 26-28 frames per second, through a rotating sector wheel, each filter of which is made up of seven sectors of different colors. A reduction in color fringing and improved color rendering is claimed.

Fire-Proofed Paper Scenery

A new kind of theatrical scenery, capable of cutting the cost of that item of a modern stage production from many thousands of dollars to not much more than as many cents, was tried out recently in the Grand Theatre in Geneva, Switzerland, the home of the League of Nations. The new scenery is made of brilliantly colored paper, impregnated with chemicals to make it relatively fire-proof and illuminated both from in front and from behind by skilfully placed electric lights. The partial transparency of the paper is said to be an advantage, since the use of special lights shining through the paper permits beautiful effects not obtainable at all with present-day conventional scenery.

Very Low Cost

The scenery and decorations for a short musical production presented between the acts at the Geneva Theatre cost, it is reported, the equivalent of less than fifty dollars. The new paper scenery is also far lighter and less bulky than the ordinary kinds. That for the Geneva production could be packed, it is reported, in two ordinary traveler's trunks.

The only reported disadvantage is that the paper scenery does not last so long as that built of wood and canvas, but in the light of its low cost it is claimed that this is not especially important.



The Daily Grind

There is a good deal of solemn nonsense being written about the elimination of hard work from industry. The tug and strain, fret and sweat of the daily job are supposed to have disappeared among the unskilled, and, as for the skilled, why, they are supposed to have reached a state of performing mere parlor tricks.

But for these sentimentalists, let them follow the bricklayer who lays his hundreds of bricks in eight hours, when the thermometer hovers near 95 degrees. Or let them keep up with the carpenter mounted on the cone of a slate roof, sawing out a dormer window. Or let them chase the plumber, or the lineman, tying in, or the inside wireman pent up in a narrow space between four walls, while the summer's sun sends the mercury up to 95.

No, there is a lot of the old pain left in the daily grind. There is a lot that calls for nerve, patience, dogged stamina, and the heart of the true athlete. The millennium is not here; if it were, then employers would not be so willing to get rid of the man 45 years old, to make room for youth, with taut muscles, with daring heart and patient back.

Machinery has eliminated some drudgery. That is well. But let's not be fooled. There is still enough of backache, eyestrain, and heartbreak in manual labor to confound the theorist, and to make the servant more than worthy of his hire.—*Electrical Workers' Journal.*

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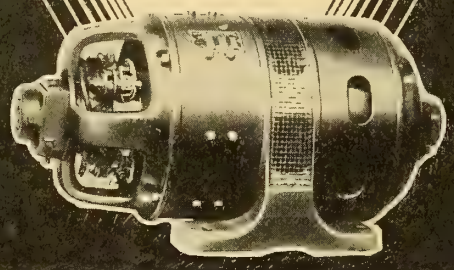
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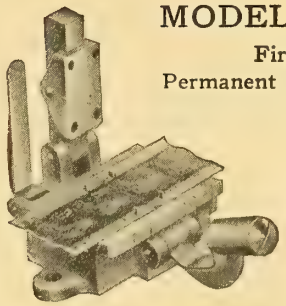
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Projection Advisory Council Press Luncheon

THE Projection Advisory Council, whose committee reports and other activities in the interests of projection and projectionists have been reported in these columns from time to time, will sponsor a luncheon at which President William F. Canavan of the I. A. T. S. E. will be the guest of honor at the Hotel Astor, New York City, on November 14th. Practically the entire official family of the Council will be present at this affair, in addition to many representatives of the motion picture trade and public press who will be the guests of the Council for the occasion.

The significance of this gathering for projectionists and those interested in the progress of projection lies in the fact that at this, the first public gathering of the Council officers and members, the friends of projection will have their first opportunity to discuss with and explain to the representatives of the press the problems of projection and the efforts of those within the craft to develop projection technique to a high point.

Committees at Work

The various committees of the Projection Advisory Council have been meeting at regular intervals within the past six months, and it is expected that the respective chairmen will be ready shortly to submit reports of their activities and recommendations.

The luncheon on November 14th is in line with the announced intention of the Projection Advisory Council at the time of its formation to press for a better understanding in all quarters of the importance of projection and a stressing of the new responsibilities of the projectionist craft with the coming of sound pictures. The Council is in no wise interested in the purely local happenings of projection organizations but rather in the broad general aspects of the betterment of projection work by the craft, the improvement of projection room design, the junking of antiquated or worn-out equipment, and improved physical working conditions for the individual projectionist.

It is certain that the forthcoming affair at the Hotel Astor on November 14th is the first attempt on the part of any individual or group to secure recognition of the responsibilities of the projectionist and the importance of things projection in the general scheme of the motion picture theatre. For many years those interested in the progress of the craft have realized that there was an urgent need that those within and without the industry should be better informed with regard to the technical side of motion picture production and reproduction.

Open Forum for Press

This need the Projection Advisory Council plans to supply. At the luncheon, President Canavan will address the members of the press, after which there will be held an open forum in which the press will be invited to ask questions on various an-

gles of projection work. Several specialists in projection work will be present to answer all queries submitted. President Canavan's address is expected to take the form of a broad general outline of the I. A. T. S. E. organization, with particular stress being laid upon the manner in which the craft has thus far discharged its important responsibilities and its unceasing preparedness for whatever developments the future may bring.

Charles F. Eichhorn, Vice-President of M. P. M. O. U. Local 306 is the Chairman of the Projection Advisory Council luncheon committee, reports a brisk demand for tickets for the affair. Mr. Eichhorn disclosed that requests for tickets from projectionists in Massachusetts, New York, Connecticut, Rhode Island, Pennsylvania,



Charles F. Eichhorn

New Jersey and Ohio have been received thus far, indicating, he said, that the affair is provoking much enthusiasm in projection circles.

"Projectionists everywhere should take an active interest in the work of the Projection Advisory Council," said Mr. Eichhorn, "for here is an organization which, while being thoroughly disinterested in purely local organization problems, is making a strenuous bid to generate a wide interest in all quarters in the importance of the work being done by the craft. Projectionists as a craft have never had the opportunity to have discussed by their representative leaders the many problems which are demanding attention just now.

Council Roster Representative

"A glance at the roster of Council officers and committee heads should be sufficient to prove that the Council is truly representative of the craft. Men who have earned recognition from the entire craft for their work in some special phase of projection work have been enrolled in the campaign which the Council will launch in behalf of the craft. These men are willing to give unstintingly of their time and labor for the success of the enterprise,

(*Continued on next page*)

Why Projection Experts Choose Cinephor Lenses

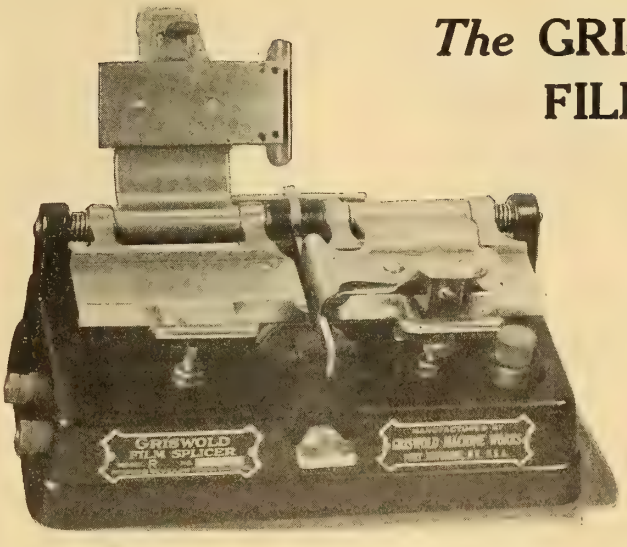
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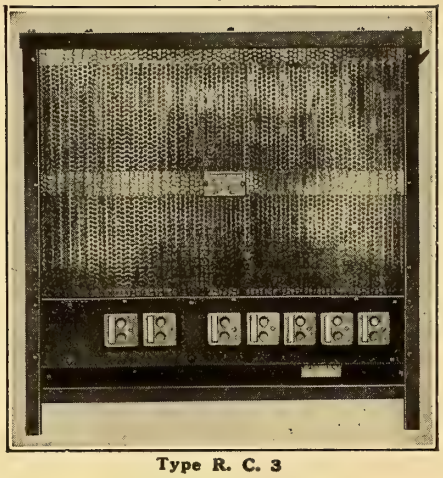
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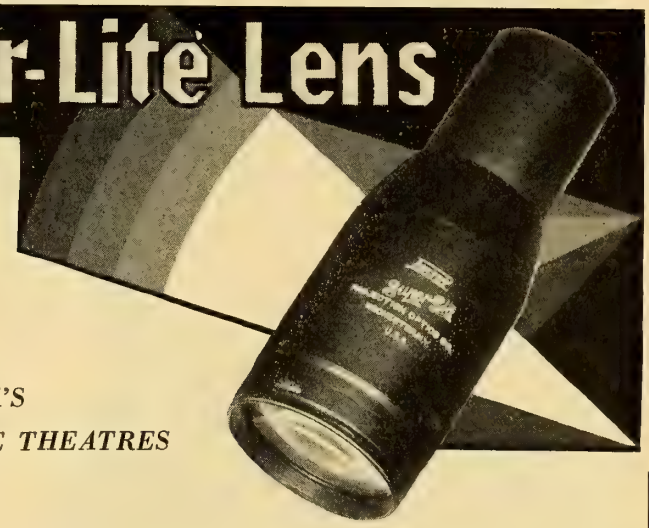
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New Exciting Lamp Serves as Battery Eliminator

Experiments are now being made with a view to finding an exciting lamp for sound picture projector systems which will use raw A.C. and thus dispense with the need for storage battery supply. The principle involved in this new lamp is based on the insensitiveness of a heavy lamp filament to the ripple, or 60-cycle alternations, of an A.C. source. In other words, it has been found that if a thin filament be used in an exciting lamp, it would correspond to the 60-cycle variations; but, on the other hand, a husky filament has been found to be insensitive to the 60-cycle variations, i.e., from an optical viewpoint, and thus the photo electric cell may be used in the circuit in which raw A.C. is fed to the exciting lamp.

A discussion in detail of this new lamp will appear in the next issue of THE MOTION PICTURE PROJECTIONIST.

P. A. C. Press Luncheon

and it seems to me that the least their efforts should merit is the support of the craft at large.

"The Council has many plans laid for important work during the coming year, and the support of the projectionist craft as a whole would serve to indicate to its officers that its efforts were meeting with the approval of all projectionists. Such support can have but one result, and that a determination on the part of Council officers to increased efforts and a widening of the scope of their work.

Council Membership

"The response to Council membership appeals has thus far been encouraging, but it would greatly facilitate the work if more projectionists displayed an active interest in this work to help them in their work. I feel sure that within a short time the Council will have proven its worth to the craft and will receive the support which its efforts merit. Probably the best way in which to stimulate membership would be to have each Local Union designate one member to represent it in the Council. In this way it would be unnecessary for every member of each Local Union to join, yet they would have the advantage of having representation in the Council work.

"I think this plan would also serve to increase manifold the value of the Council's work, what with the variety of opinions and suggestions which would be received.

"Projectionists who may be interested in the work of the Council and who wish to establish contact with it may do so by addressing the Council in care of THE MOTION PICTURE PROJECTIONIST, which will forward all communications to the proper officials."

The luncheon at the Hotel Astor on November 14th will be served promptly at 12.30. Tickets for the affair may be obtained from Mr. Eichhorn.

Inventive Trend Shown by Patents

A REVIEW of the patents taken out in the motion picture field within the past thirty years shows that they outnumber those taken out in any other field. The accompanying illustrations graphically depict the trend of interest on the part of inventors who applied their talents to solving one or more problems of the motion picture within given periods of time. These two charts cover patent activity during the years 1918-19 and 1928-29, ten years apart.

Activity During 1918-19

From January, 1918, to June, 1919, the British Patent Office issued a total of 168 motion picture patents. Ten of these were concerned with color photography and projection, 4 with synchronizing sound and scene, 7 with relief and stereoscopy, 7 with continuous motion projectors, 5 with mechanisms aiming at preventing film fires during projection, 17 are apparatuses for taking pictures, 18 with mechanical systems for film manufacture, 30 with improvements for photography and projection, 37 with minor modifications to parts of mechanisms, and 23 sundry inventions. A graph of this patent activity is presented in Figure 1.

By contrasting the percentage of the separate branches to the total number of patents, we have very clear evidence of the fact that at the period in question the most pressing need of the cinema was for the improvement of its technical means.

Although cinematography was then in its twentieth year, it had attained but a limited degree of perfection, both in its expression and in its means of production. The inventions which give the highest percentage are those dealing with apparatus for taking the pictures, for projecting them, and for the mechanical preparation of the films; these needs were too urgent to leave much scope for attempts of a more ambitious kind. Color, sound, relief, were attractive ideas, but cinematography pure and simple had to be perfected in its essential elements before paying attention to the superfluous.

Trend During 1928-29

Let us now glance at the patents issued by the Patent Office, during 1928-1929, during the same lapse of time. Out of 256 patents, 52 are concerned with color, 57 with synchronism, 21 with stereoscopy, 8 with continuous motion, 10 are mechanisms to avoid fire, 9 filming apparatus, 5 mechanisms for preparing films, 30 for perfecting projection, 23 sundry inventions in the technical and photographic field.

This review shows that the highest percentage of patents are concerned with synchronization and color; there is a noticeable increase in the number of stereoscopic inventions, hardly any difference in the number of those dealing with continuous motion and with anti-fire devices. On the other hand, we find a striking decrease in the number of inventions for perfecting material for film manufacture, filming, projection and similar devices. All this tends to demonstrate that, while the possibilities of further perfecting existing systems are not overlooked, the spirit of invention is mainly directed to the solution of three problems which were almost entirely neglected three years ago, but which today represent the goal of all inventors. —*International Cinematographe.*

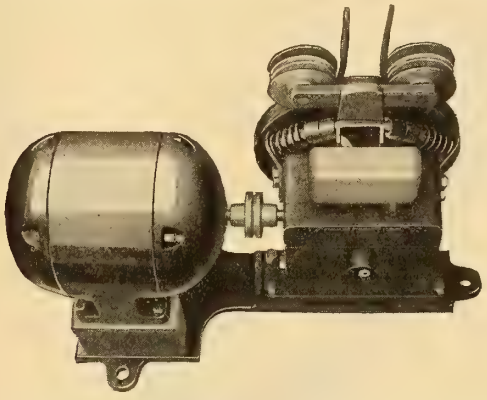
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insulation and is provided with a long shaft and special mounting bracket. It is suitable for use as a heavy-duty line control, variable speed motor control, plate voltage control for transmitters, field control for shunt type generator, and so on.

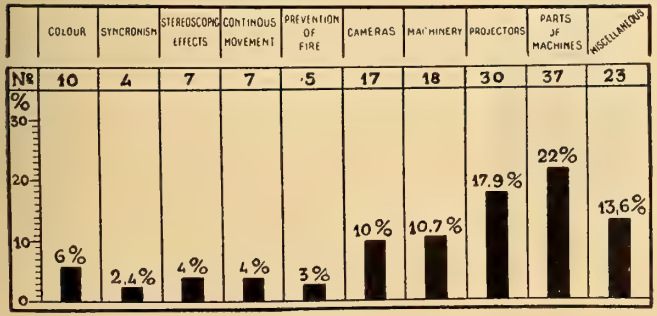


Figure 1

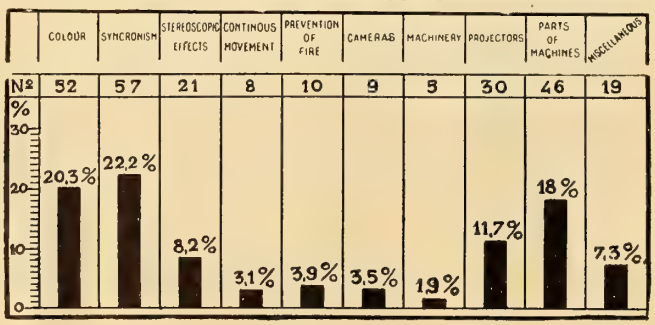


Figure 2

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Pres. Canavan Addresses S. M. P. E. Meeting

THROUGH a fortunate coincidence the American Federation of Labor was holding its Convention at the Royal York Hotel in Toronto at the same time the Society of Motion Picture Engineers was in session there. Attending the A. F. of L. Convention was President William F. Canavan of the I. A. T. S. E. Through the efforts of P. A. McGuire, of the International Projector Corp., it was arranged with President Porter of the Society to have President Canavan address the Engineers.

There is absolutely no doubt that President Canavan's remarks were extremely well received by the Society. He is a finished speaker with the ability to attract and hold the attention of any body of men; and it should be a source of great satisfaction to projectionists that they are so well represented on all occasions by such an outstanding and capable leader.

We regret that we had not time enough prior to publication of this issue of THE MOTION PICTURE PROJECTIONIST to secure a complete transcript of President Canavan's remarks, together with some excellent photographs of I. A. groups which were taken during the Toronto meeting. We anticipate having all this material ready for publication in the next issue, and it will give us much satisfaction to present it therein. Meanwhile, we are able now to give this brief but highly interesting extract from President Canavan's address:

"From an experience of many years in the American trade movement and a deep intimacy with labor problems, I know of no group of wage-earners which has given as much time to the scientific consideration of their work as the motion picture projectionists. Frequently in labor unions it is largely a matter of better wages and better working conditions, but the motion picture projectionists are the outstanding exceptions among wage-earners who give a very large part of their time to studying the scientific aspects of their work."

J. F.

Care of Motors

(*Continued from page 37*)

The brush tension should be checked regularly to make sure that the proper tension (1¾ lbs. to 3 lbs. per sq. in.) is maintained by the spring.

Fitting—When replacing brushes, they should be fitted by means of fine sandpaper folded around the commutator and the rotor revolved by hand in the desired direction until a proper fit is obtained.

On some machines, the sandpaper can be held in place if it is cut to a width slightly narrower than the commutator, and the front end of the strip inserted into one of the narrow slots between commutator bars (where the mica has been undercut), and then folded back around the commutator by slowly revolving the armature by hand until the paper moves under a set of brushes.

Position—An operator should never shift the position of the brushes unless he knows positively that the brush position

Care of Lenses

OPTICAL glass is relatively soft and for this reason it is very easy to make the mistake of cleaning a lens too well. In place of the beautiful black polish of a new lens there appear little fine scratches, increasing the surface area potentially capable of being affected by tarnish. Such lenses give less brilliant images because of light scatter at the surface.

As precision optics advanced with the advent of new types of glasses, giving greater range to the formula variations due to the greater differences in refractive index, dispersion and absorption of the raw material, it was found that some very suitable glasses were also subject to tarnish and corrosion. Glasses with a lead constituent would darken by fumes of sulphur, found in sewer gases, chemical fumes, leaking gas jets, etc.

Some glasses, being highly hygroscopic, would condense moisture upon their surfaces, and this in turn avidly takes up hydrogen sulphide from sewer gas or illuminating gas and in turn attacks the glass surface with a tarnish. Ammonia fumes similarly make an alkaline solution. Acid fumes likewise are picked up by the moisture coating.

Tarnish and Corrosion

The remedy is obvious: keep your lenses dry and away from dampness. These hygroscopic glasses and others that disintegrate are avoided, because lens makers have gained in experience and now have many other glasses available. In several cases lens series were recalled and remedied. Greasy lenses may tarnish from perspiration marks when left for a long time. Lenses should be blown free of dust and lint and wiped with clean linen, using a little moisture from the breath.

It is rather disheartening to the manufacturers of lenses to have their cautions against use of alcohols and acids flouted from time to time by experts who deliberately advise this remedy for cleaning lens surfaces. The unfortunate reader of such articles finds that there is a legitimate charge for repairs, often for regrinding and repolishing the damaged surfaces. This is the only way to renovate a tarnished lens. Such lenses often work all right, perhaps with a slight absorption showing up, and tarnish should not be confused with yellowing of cement or cracked cement, a temporary condition, which can be easily remedied.

---

is incorrect or it is desired to change the direction of rotation or the mounting of the machine. On machines with commutating poles, the position of the brushes is fixed on the neutral point at the factory and the position of the brushes on such machines should never be shifted except to make changes as indicated in the previous sentence or for compounding or parallel operation of generators.

Pigtails—Care should be taken to see that the pigtails or flexible copper conductors are firmly fastened in place so that they will carry their full current from the brush to the brush holder.

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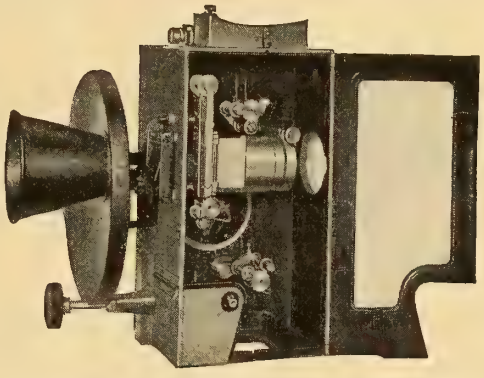


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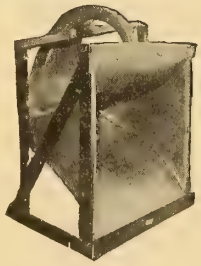


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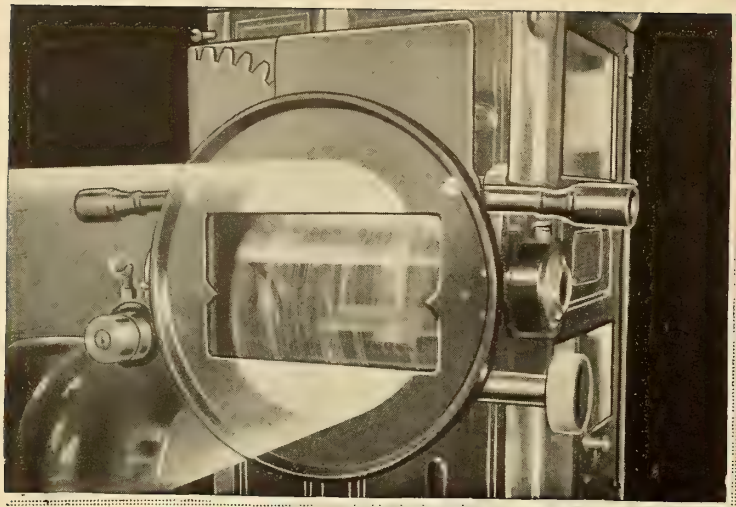
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PROJECTIONIST

December 1929

James J. Finn, Editor

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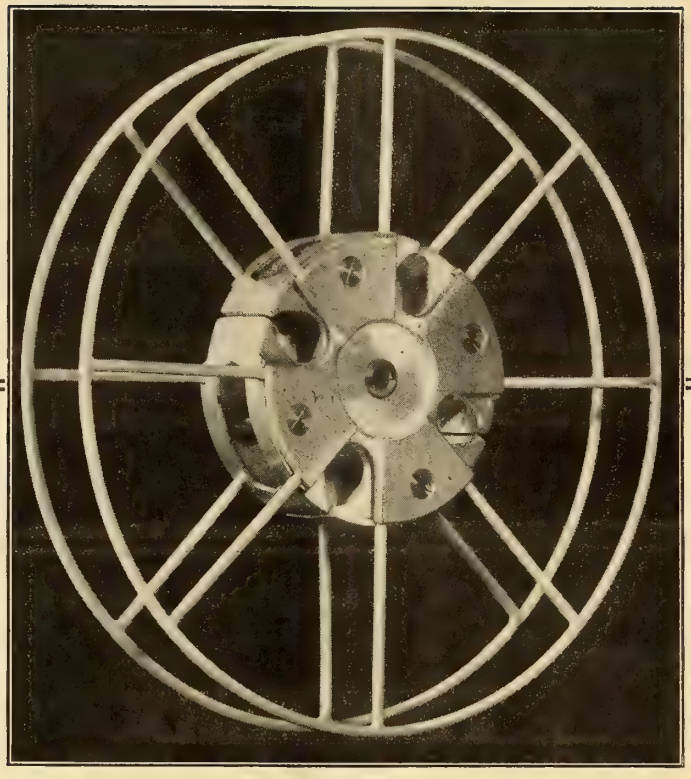
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December, 1929
Vol. 3, No. 2

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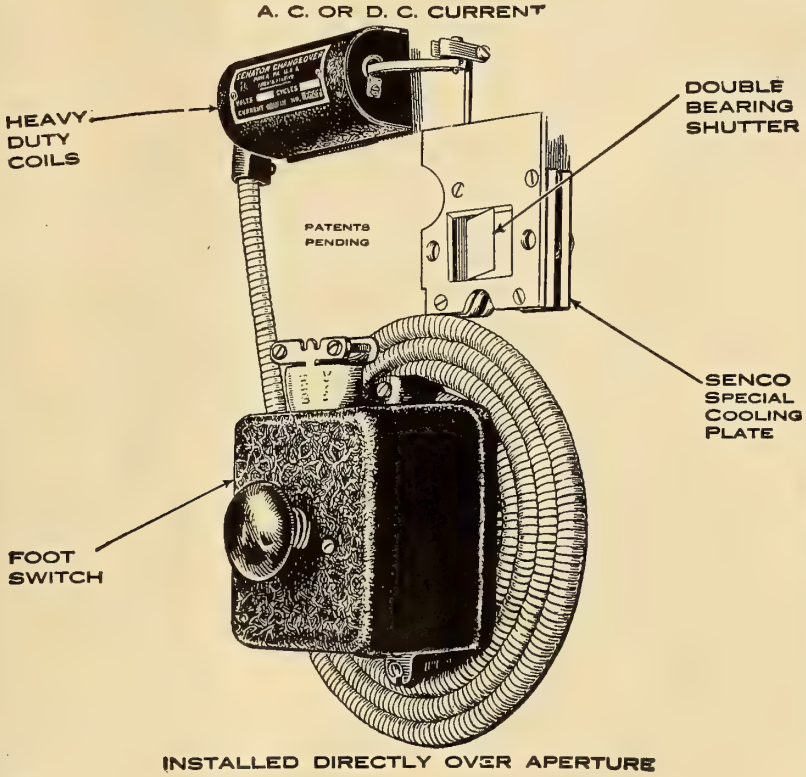
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"Sovereigns of Sound"

THE motion picture operator once was just the man who turned the crank. Now he is an artist, a sovereign of sound, the master of talkie fate. These "projectionists," as they are called, do not, however, give themselves those lordly titles. Though they manipulate the limelight, they keep out of it themselves. They do not speak like Hollywood stars of "my public." They subordinate themselves to their exacting technique by calling themselves projectionists.

They are indeed engineers, for they manage a very complicated piece of mechanism. But they are more than mechanics. It is said of them that even though they be good electricians, well-versed in the laws of optics and acoustics, as dexterous in doctoring their machine in full flight as an aeroplane mechanic who crawls out on a wing and repairs his machine in full flight, all these virtues are nothing if they have no sense of the theatre, if they are not stage managers and showmen.

The Marvelous Duo

I watched two projectionists in action in a big Toronto sound picture house. I had to go to the very roof of the theatre and then climb other stairs to a superroof. It gave me the feeling of climbing to the crow's nest of a ship. They were indeed like look-outs keeping watch in foggy weather. From their peep-hole they kept their eyes steadily fixed on the screen far below them and were ready to spring to a switch or a lever at the least sign of visual or auditory deficiency.—*Toronto Star Weekly Magazine.*

7,000 Show Musicians Idle

More than 7,000 out of a total of 25,000 members of the American Federation of Musicians who were formerly employed in theatre work are now out of work, according to official figures issued from the national headquarters of that organization. No secret is being made of the unrelenting opposition of Federation officials and members to the "talkies," as they term them, and a spirited advertising campaign, estimated to exceed a cost of more than $250,000, is now in progress to acquaint the American people with the dangers of "flat, savorless, mechanical music."

President Weber's Statement

In a recent statement President Joseph Weber of the Federation said: "A great cultural calamity awaits the United States if its citizens allow one industry to force it into an acceptance of flat, savorless, mechanical music." Weber also cites many letters and telegrams which have been received from all over the country as evidence that the Federation has the moral support of many thousands in its fight against sound pictures.

Dissension and lack of harmony handicap the trade union, but co-operation and the union label solidify it.



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WITH National Projector Carbons behind your films you can be sure of a good showing. Clear projection brings satisfaction. The modern soft, low key or fuzzy film, shot with trick angles or light-absorbing prisms, requires greater illumination to get the effect on the screen . . . that means stepping up the amperage. National Projector Carbons burn smoothly on increased amperage . . . produce greater light without spitting or pitting. This insures clear, flickerless pictures — pictures that please the audience and are easy to look at. With good films and good projection your theater will stay crowded. National Carbons help keep attendance growing.

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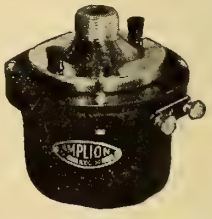
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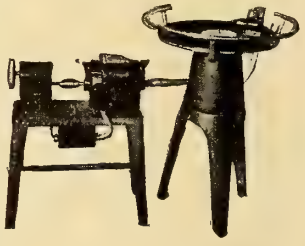
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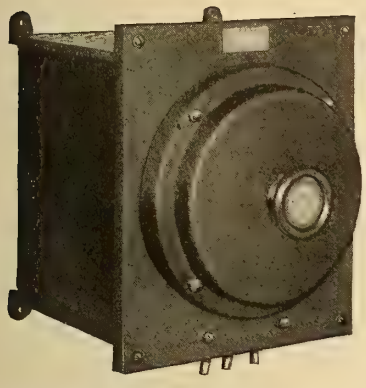
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Perfect Projection is dependent upon a number of factors aside from the Projector itself, and also upon TEAMWORK between these factors.

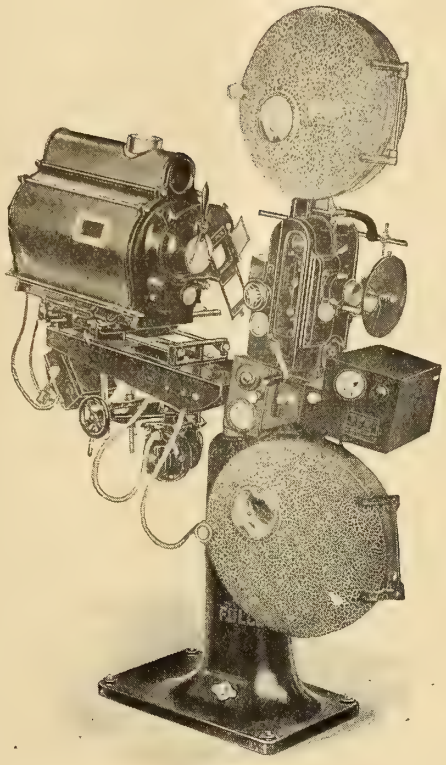
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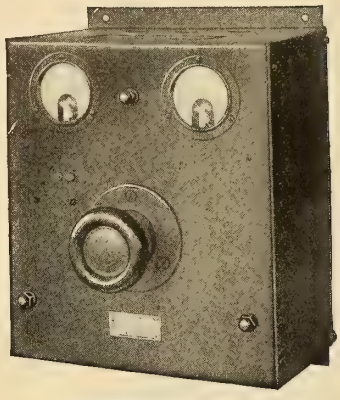
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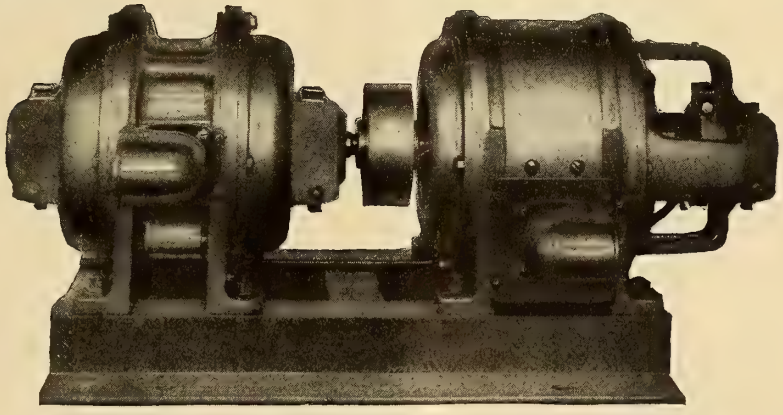


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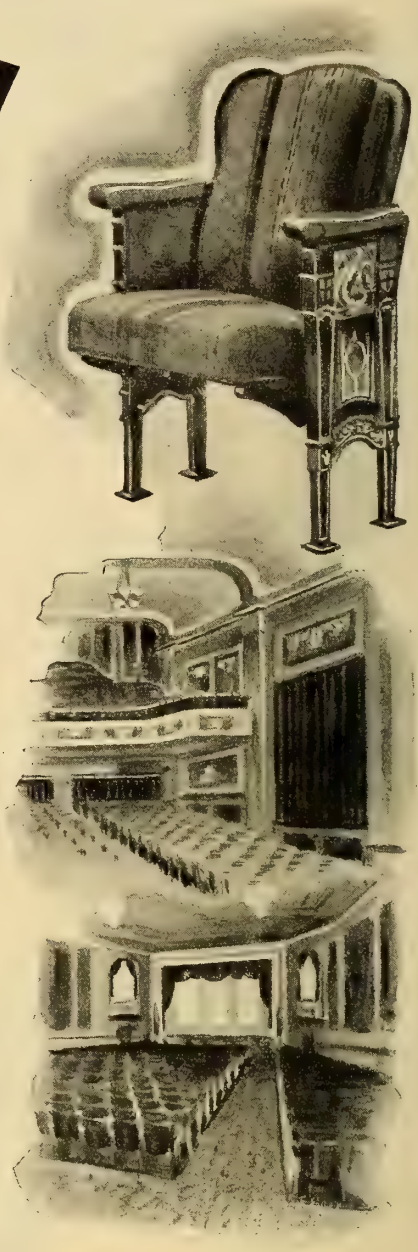
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Nine times out of ten—providing sound equipment is good—unsatisfactory talkies are the result of poor acoustics. In these days of perfected talking pictures the public is rapidly getting more and more insistent on clear, distinct voices.

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"Well, Maybell, I went like you told me and saw the pichure that you was ravin' to me about and, believe me, **saw it** is exactly what I done. I gotta go back again if I want to **hear it.** We was late to begin with, and hadta perch way up among the chandeliers and any time anybody said somethin' in the pichure, why it sounded up there like about sixteen old maids at a tea. They was echoes or somethin' all over the place and so, with all this clatter that didn't mean nothin', and Paddy decidin' to get amorous, you woulda thought we was at a Sunday School picnic.

"So Paddy says, when we got outa the place. 'Pretty good sho, wasn't it, kid?' and I says, 'I'll bite, was it?' (How should I know if the show was good if I couldn't hear what it said?) 'Listen, sap,' I says, 'I know my talkies and where to go to hear 'em.'

"'Oh, is **zat** so?' he says. 'Poisonally, I tought it was a swell pichure.'

"'Oh, yeah', I says, 'well **you would** because in the first place, if I got any memory a tall, your mind wasn't at no time on the pichure, and furthermore,' I says, 'don't never ask me to come back here to take in another of your swell talkies in the silent. I simply gotta take my art straight or not a tall.'"

NATIONAL THEATRE SUPPLY COMPANY

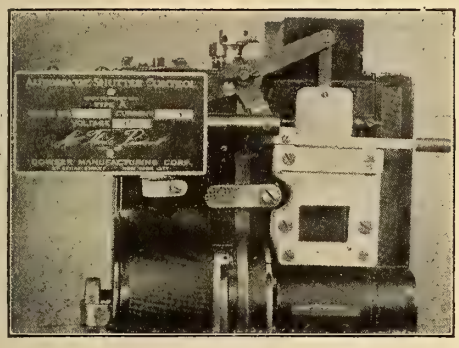
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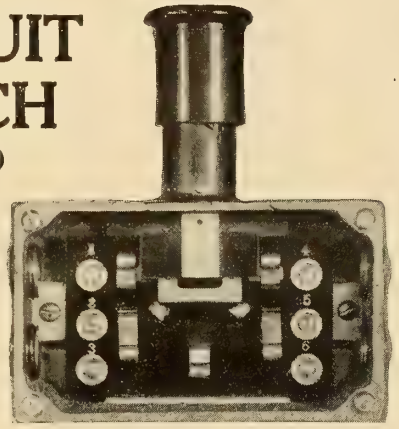
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He Was Mistaken!

Are You?

"No, Ma'am, we don't have any talkies in this theatre."

"What! No talkies? Only silent pictures?"

"Yes, Ma'am. You see, it costs so much money to install the talking equipment—"

"Well, that's just too bad, but I'm going to a theatre that has talkies."

—and that's just what she—and millions of others are doing.



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By Installing

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Spring Suspension: The Syncrodisk patent that spells steady even motion. The secret of fine talkies.

Metal Guard surrounding the disk has two pockets for needles. *Not Driven Off Intermittent.*

Installation: Can be made by any operator and wire man. In one hour you are ready to run the standard 16" synchronized disks.

Comes Complete with two pick-ups and change-over fader.

More Than 400 now performing smoothly every day.

When your patrons ask you when you are going to give them talking pictures what answer will you make? Get in step with modern progress and give the people talking pictures. Install the machine which is quality personified—built by Weber whose tradition is precision—the only Turn Table with Spring Suspension. Install two Syncrodisks for the small sum of $500 and watch the increase in business.

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Equipment Troubles and Maintenance

BY C. R. TRAVIS

II

LAST month we discussed ways and means of tracing trouble to one of the four major portions of the sound reproducing system. In this installment we shall resume where we left off, which was, as you remember, with the assumption that the trouble was to be found in the reproducer portion of the equipment. From this point we shall proceed to make a final analysis and clear the trouble.

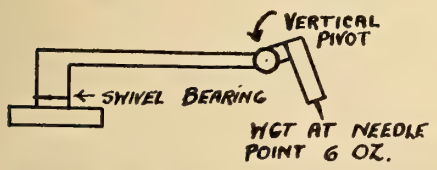
Disc reproducers or magnetic pick-ups ordinarily will give little trouble, unless, of course, they are subjected to improper handling. The attendant circuit is a simple one. It consists merely of a pair of wires leading from binding posts on the reproducer through the tone arm and to a knockout box located on the front wall of the projection room. From this latter point connection is made direct to the fader binding posts corresponding to that particular circuit. Any trouble which is located between the pick-up and the fader may be readily located by means of earphones, as described in the last issue.

In one of the major companies' installations, however, this circuit takes a somewhat different path. The circuit leaves the reproducer and follows the reproducer arm to the swivel bearing, passes through the tone arm and there enters conduit, from where it is lead through a connection box adjacent to the amplifier panel and then into an equalizer panel mounted on the amplifier rack. The circuit then leaves the equalizer panel, returns through the connection box and goes to the fader terminal posts. The equalizer is for the purpose of flattening the characteristics of the reproducer and probably would never give any trouble.

Other Reproducer Troubles

Perhaps the most common trouble with disc reproducers is the jumping of the record groove by the needle; this and the problem of maintaining synchronism are the usual faults of reproducers. Both these faults may be the result of one or a combination of causes. A listing of these troubles in the order in which most complaints are made follows:

1. Vibration in the turntable.
2. Poor records.
3. Tightness at the swivel bearing.
4. Improper reproducer drift.
5. Needle not meeting the record at the proper angle.



Tone arm with vertical adjustment at end

6. Improper handling—rough usage.
7. Insufficient mass in the reproducer and reproducer arm assemblies to hold the needle in the record groove.
8. Too high a mechanical impedance in the reproducer.
9. Turntable not level.
10. Use of incorrect needles.

Turntable Troubles

Turntable troubles usually are the result of improper alignment of the table with respect to the projector or its driving element. The turntable must set level, and the center of the drive shaft of the turntable gear pot must be in the same plane at all angles with the center of the driving shaft. To obtain these conditions proceed



Cross-Section of a Record

Any average reproducer will follow grooves 1, 2, and 3. Only a well-designed assembly will follow 4 without breaking into 3 or 5. Only a perfectly adjusted assembly will follow 5 or 6 without jumping.

as follows: Disconnect the driving mechanism from the turntable gear pot and carefuly level the table by means of the leveling screws at the base of the pedestal. Raise or lower the pedestal in its base until the column is approximately at the level required to bring the two drive shafts to the same height. Complete this adjustment by means of the leveling screws.

Turning all of the leveling screws an equal amount will not affect the level of the turntable. Move the base of the turntable until the two shafts line up in a straight line. This procedure must be repeated until perfect alignment is attained. The tools required are a crescent wrench, a level about 8" long, and not a little of that virtue known as patience.

In projection rooms having linoleum floors or rubber pads in under the turntable legs there is need for a daily adjustment for about a week after the leveling-off process, to check up on any compression of either linoleum or rubber. After the turntable has apparently settled permanenly to such flooring it is advisable to check weekly so that there may be no shifting.

The coupling device usually consists of a rod of some type connected to the driving and driven shafts by means of rubber connectors. These connectors should neither be compressed nor stretched under operating conditions, and every effort should be made to remove the wobble inherent in this type of coupling. Usually a wobble in these couplings indicates that the shafts are not properly aligned or that the coupling is being compressed. It will be found that if this set-up is rigidly adhered to, turntable vibration will be practically eliminated.

Poor Records

A reproducer that jumps at one particular spot on the same or like records is generally not at fault, unless it is noted that this happens altogether too often with various sets of records. When this condition is encountered the records should be examined carefully with a good grade of magnifying glass. If the grooves appear to run together and the side wall between the two grooves has the appearance of being overcut, it is safe to assume that the reproducers are functioning satisfactorily.

Tightness at Swivel Bearing

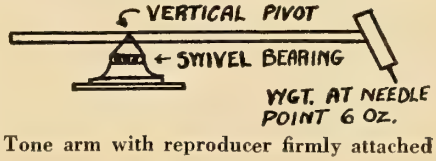
A reproducer which jumps at the same physical location irrespective of the record shows that it is being held from tracking by its bearing or some outside cause; and the reproducer arm swivel bearing should be inspected at once. If the tightness cannot be located, change the entire reproducer arm. A typical case in point is one where the cords leading through this bearing had become twisted and were exerting back pressure enough on the reproducer to cause it to jump.

Either of these conditions can be recognized by taking the reproducer in one hand and gently swinging it through the path it normally follows. Any tendancy to stick on the part of the reproducer will show that the arm is not working satisfactorily.

Improper Reproducer Drift

By "drift" of a reproducer is meant the tendancy to swing to either one side or the other with respect to the top of the turntable. The generally accepted theory is that the "drift" should be such that the reproducer, when given a slight jar, should start from the center of the turntable and move toward the outer edge in its normal direction of travel, slowly and without further urging. This test may be made by either counter-balancing the weight of the reproducer on the tone arm by placing a wrench or other object at the back end; or in the case where the vertical movement of the reproducer is provided for at the reproducer, by fastening it up and back against the arm. If the drift is not correct, adjustment should be made.

At the top of nearly all pedestal tone arm brackets there is a platform in which



Tone arm with reproducer firmly attached

the tone arm assembly sits. This platform can be tilted to give the reproducer arm the required drift. The entire assembly should be raised or lowered on the pedestal to make the reproducer arm level when the reproducer is in its operating position. Be sure that the lock rings are tight against the felt and that there is no motion in the pedestal tone arm bracket before okaying the adjustment.

Proper Needle Angle

The needle must be vertical on the record as seen from the front of the reproducer. If it is off even slightly it will not ride the record groove properly and will jump frequently. The reproducer can usually be rotated sufficiently in the arm to correct errors of this type. Looking from the side of the reproducer, the needle should meet the record at an angle of between 65 and 85 degrees.

Dropping a reproducer onto the record or turntable will sometimes bend the armature and cause the reproducer to induce a rattling or blasting sound in the speakers. This condition should not be confused with the perfectly normal noise that is made when running through heavy music cuts on the record. Manufacturers recommend that defective reproducers be returned to them for repairs, and projectionists should not be slow to avail themselves of this opportunity to replace defective equipment.

Insufficient Reproducer Mass

Some makes of reproducers are too light for the work assigned to them. This statement must not be confused with the weight of the needle upon the record, which is an altogether different matter. Ideal reproducer weight has been generally standardized at between 4 and 6 ounces, as with less weight there is a tendency to jump the groove; while excess weight damages the record to the extent of making it worthless after a few playings.

The reproducer should have sufficient mass so that it will not be thrown by the action of the needle as it endeavors to follow the grooves of the record, particularly on heavy bass notes. In cases where the reproducer is fastened solidly to the tone arm, and the vertical motion is obtained by a bearing at some point along the tone arm, it is easy enough to add weight to both sides of this bearing to make mass and prevent the reproducer from being thrown. In doing this be sure that the weights are so distributed that the pressure of the needle on the record is not in excess of 6 ounces. There is nothing that can be done with reproducers that are hinged to the tone arm to allow for vertical motion.

High Mechanical Impedance

High mechanical impedance results from an armature so rigid that it does not allow the needle to follow the groove, and in the case of an assembly having a large mass, simply pulls the needle through the groove; or, in the case of a light mass, allows the needle to throw the reproducer. Either case will cause the reproducer to jump or ruin the record by breaking down the side walls of the grooves.

Correct needles are specified by the manufacturers of the various sound picture equipments, and it is always a good practice to follow these recommendations explicity in order to secure the best results.

(To be Continued)

Why 1,000-Foot Reels?

EXPERIENCE has taught film producers that the use of single, or 1,000-foot, reels with sound-on-film subjects is conducive to bad prints and poor presentation of sound pictures. Most of the leading film producers have adopted the practice of shipping sound-on-film subjects on 2,000-foot reels, thus making it unnecessary for the projectionist to delete any sections of film for the purpose of joining up two short reels. However, there are still a few producers who adhere to the old custom of shipping on single reels, and this practice has done much to mar the presentation of many sound pictures.

The evils attendant upon the continued use of 1,000-foot reels are admirably set forth in the following communication from a Local Union Secretary, whose Local members have experienced much difficulty in properly presenting sound film subjects. Most of the disadvantages of short reels are set forth in this letter, and those which are not stressed are too well known to projectionists to need further comment here. The letter follows:

We would like to have you take up with the producers of Fox Movietone feature pictures the matter of their putting out their multiple reel subjects on 2,000-foot reels instead of on 1,000-foot reels, as at present. No one runs either silent or sound-on-film subjects on single reels, no matter how they are shipped from the exchange, and all such reels are doubled up into approximately 2,000-foot subjects before they are run.

Render Cue Sheets Worthless

As these subjects come on single reels, they must be cut again after using, so that they may be sent out on the original shipping reels. This means 2 cuts on the end of every odd-numbered reel and 2 cuts on the start of each even-numbered reel in each theatre where the subject is shown. We have reason to believe that even here where all our projectionists are first-class men, careful and conscientious, this continual cutting does not help the picture any. Due to censor cuts, etc., some reels are very short, while other reels are filled. When separating such reels after they have been doubled up the tendency is to even up, or balance, the footage on each small reel. This means that after the first run the original cue sheets are worthless.

In doubling up, in order to have a continuous picture on the screen, the cut is made at the last picture frame on the one reel and at the first frame on the next, except in cases of a fade-in or fade-out. In some cases the sound record runs on past the last picture frame, and then we are faced with the choice of cutting off that stretch of sound record (perhaps dialogue), or having our screen go dark while the sound is permitted to run. In cases where the sound runs right up to the last frame, or starts with the first picture frame, quite a bit of sound and picture are missing by the time the print has been around to a few theatres—because every time the single reels are doubled up and separated a full picture frame and its accompanying sound record are lost.

Audience Reaction

We all know that there are many good reasons why all sound-on-film subjects should be sent out on 2,000-foot reels, and a number of companies are doing this with both features and comedies. I earnestly request that you take up this matter with those companies not now using 2,000-foot reels and thereby render a great service to all branches of the industry.

We projectionists have no interest in view in pointing out these little defects in the sound picture scheme other than to render the whole industry a service. The splicing together of short reels means very little in our daily routine, yet it simply doesn't set right with us when we see good feature pictures, costing many thousands of dollars to make, being marred constantly by the small matter of larger reels. Such things do not please the picturegoer, and I believe this is the purpose of all of us in the industry.

F. P. BROADBENT,
Secretary Local 360,
Edmonton, Alb., Canada.

The Perfect Speaker

WHAT would be the characteristics of a perfect loud speaker? In the first place, a perfect loud speaker would reproduce all the frequencies over the entire audio-frequency band which extends from say 15 cycles up to about 12,000 to 14,000 cycles. It would reproduce all these frequencies without discrimination, in other words, a response curve of its performance would be "flat" over the entire band. The perfect speaker would introduce no new frequencies; that is, if supplied with a pure 60-cycle current it would produce a pure 60-cycle note and not a complicated tone consisting of some 60 cycles and also some of the harmonies of 60 cycles.

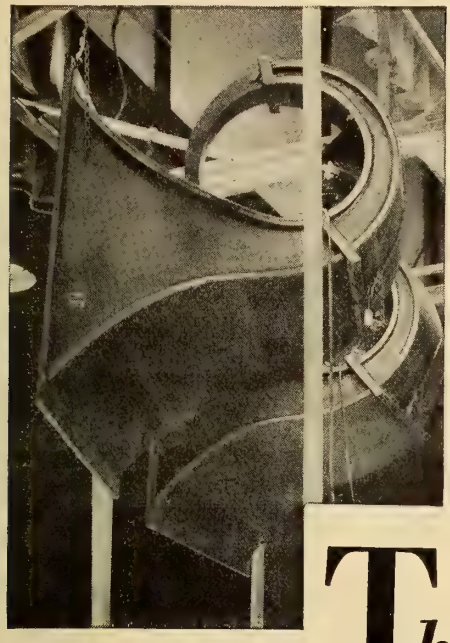
It would be capable of handling the maximum desired volume without distortion due to overloading or rattling. It would be efficient, converting all or nearly all of the electrical energy supplied to it into sound. It would have a very long useful life and be not in the least affected by dampness or other atmospheric conditions.

Audio Frequency Range

The problem is how far the practical speaker can depart from the ideal and still be satisfactory. The range of audio frequencies extends from about 15 to 14,000 cycles, but the problem is to decide how many of the low frequencies and how many of the high frequencies can be eliminated before serious distortion results.

Competent authorities feel that essentially perfect reproduction can be obtained in the frequency band between 30 and 10,000 cycles, the elimination of all frequencies above and below these limits causing no noticeable change in quality. Further it has been found that cutting the frequency band from 10,000 down to 6,000 or 7,000 cycles produces but a very slight change in quality—a change that can only be detected by a direct comparison between the original and the reproduction.

THE FOURTH OF A SERIES ON QUALITY REPRODUCTION *by* WESTERN ELECTRIC



The Voice *is a* Precious Cargo . . . guarded from actor to audience through a great chain of men and apparatus so that when it reaches the loud speaker it shall be true and faithful.

If the loud speaker fails to operate efficiently, even the best pictures will not "click."

That this final link shall *not* fail, the Western Electric Sound System uses the horn speaker—developed by the Bell Telephone Laboratories—backed by over 50 years of research and experience—a direct descendent of the first telephone receiver invented by Alexander Graham Bell!

The WESTERN ELECTRIC HORN SPEAKER *delivers it* ten times *as* Efficiently *as any other* . . . . . .

IT requires just one tenth the amplification to produce the desired volume without distortion.

It comes nearest to reproducing the entire range of music and voice—over-emphasizing none of the notes. It does not play up the low notes by sacrificing the high. These high notes are essential to quality sound reproduction, to preserve the color, charm and individuality of the actor's voice.

Its directional effect creates the perfect illusion that the voice comes from the lips of the actor on the screen. With speakers that lack direction, illusion is lost.

It is designed especially to direct the sound to all parts of the theatre in equal volume, bringing words and music clearly to every person in the house, and overcoming many acoustic faults. With speakers lacking directional effect this is impossible.

The Horn Speaker Contributes to Quality in the

Western Electric SOUND SYSTEM

THE VOICE OF ACTION

Distributed by

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Member of Motion Picture Producers and Distributors of America, Inc.—Will H. Hays, President

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PROJECTION

Screen Presentation is an Important Part of Good Showmanship

THE MOTION PICTURE PROJECTOR is no longer a mere mechanical contrivance, cranked by hand, or made to operate by the simple closing of a switch. The Projectionist of Today must have an excellent knowledge of mechanics, electricity and optics and is in charge of a delicate and complicated mechanism made with scientific accuracy to handle a fragile and inflammable material.

THE PROJECTIONIST has a great responsibility—for a failure to measure up to the right standards means that all the producer, director, actor and cinematographer have striven for loses much of its artistic and commercial value, — the pleasure of the audience is lessened,—the exhibitor is subject to constant and unnecessary expense, —and lives and property are endangered.

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90 GOLD STREET **NEW YORK**

Synchronizing Record Starts

By ARTHUR B. REEVES

The International Photographer, Hollywood

DURING my recent trip East I visited many projection rooms. While in New York City I visited the projection rooms of the Paramount, Roxy and Capital theatres, all Broadway houses. In each instance I inspected the sound equipment and asked the projectionist in charge many questions regarding synchronization. I also discussed the relative difference between sound-on-film and disc recordings. To my surprise many projectionists stated that they get better quality of tone reproduction from discs, but in all cases they said that sound-on-film is much easier to run and causes but little trouble, comparatively.

The projectionists with whom I talked regarding sound film breaks stated that they have very little, if any, trouble with film which has a sound-on-disc accompaniment. With disc accompaniments it has been found that the starts are chewed up by the sudden starting of the projection machine, resulting very often in considerable trouble in placing the needle back into the proper groove to insure synchronization.

Record and Projector Speed

While in Chicago I was in touch with George Moore of Local 110, projectionist at the Metropolitan Theatre in that city. Together we worked out a method whereby, when the leader of a sound-on-disc film is broken off, it is possible to put the needle in the proper synchronizing groove, notwithstanding.

Now, let us consider the ratio between the record and the speed of the projector. The projector runs 1440 pictures per minute, and the record makes 33⅓ revolutions per minute. When worked out, it is found that there are 42.3 picture frames to one revolution of the disc. You will note in Figure 1 a regular Vitaphone record with the starting mark. In Figure 2 you will note a regular Vitaphone record with a scale dividing the record into 43 equal parts, beginning at the starting mark. This scale does not, however, interfere with any of the markings on the record. It can be a part of the label or can be stamped in the matrix when the record is made. In Figure 2 you will also notice a portion of the center label given over to a scale which relates in various footages to the correct starting points.



Figure 1—Regular Vitaphone record, with center panel numberings.

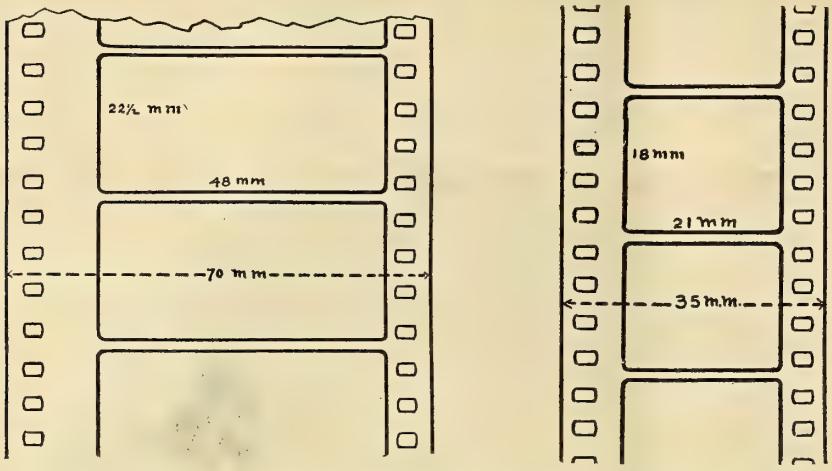


Figure 2—Center panel of Vitaphone disc with 43 equal divisions.

Scale of 43 Positions

For example, suppose we are making a changeover from the fourth to the fifth reel of a feature, and as we do so the machine "chews up" a portion of the leader (at the start) of reel five. The show is interrupted, the theatre is dark and the audience is waiting impatiently for the resumption of the show. In the past it has been necessary for the projectionist to take the whole reel out, measure off the portion of film that has been mutilated and add a portion of equal length; then to re-thread the projector and start off from the synchronizing point. This operation requires considerable time.

With the scale of the 43 positions upon the record, however, the projectionist has



Diagrammatic representation of new Fox Grandeur and standard film sizes.

but to look at the edge numbers which are on the side of the film and which run consecutively from the start, to determine the exact footage of the damaged film. For example, let us say that the projector has been re-threaded for five feet beyond the starting point.

As we thread the projector we know that we are exactly five feet from the starting mark of the film. We now turn to the record and note upon the scale printed on the label that five feet of film requires one turn and 38 frames. With the turntable stationary, we place the needle on the starting mark. We turn the record, with the needle in the groove, *one turn and around again to 37 upon the dial.* We have now attained perfect synchronization with the film and we may start the projector.

This can all be accomplished so quickly that the interruption is so brief as to preclude any demonstration by the audience of its feelings. As previously stated, it is very seldom that the film breaks in the middle of the reel, the bulk of trouble of this nature being encountered at the start when leader is mutilated.

Film Edge Numbers

All positive film is numbered along the edge consecutively and these are known as footage numbers. At every foot of film a number appears, with the numbers running consecutively to the end of the reel. Vitaphone subjects have a special numbering of their own, which may easily be distinguished from other markings. In the foregoing example where it was assumed that five feet of film had been "chewed up," suppose we should have threaded the projector at five feet *and three frames.* In this case we would simply add the three frames to the scale, and instead of one frame and 37 frames on the scale it would be one turn and 40 frames. Therefore, no matter what the footage, it will be simple to place the needle in the proper synchronizing point.

The Footage Scale

Below is printed the scale which is used for calculating the synchronization of disc and film. Previously I quoted 43.2 picture frames to one revolution of the disc, therefore we have divided the record into 43 equal parts. The .2 difference is compensated for in this scale. This scale runs up to 25 feet, but in cases beyond 25 feet it is only necessary to add the additional to the 25-foot requirements.

This method is protected by Edgar J. Clarkson, patent attorney, 905 Victor Building, Washington, D. C. The scale follows:

Feet	Turn Disc	Frames
1		16
2		32
3	1	5
4	1	21
5	1	37
6	2	10
7	2	26
8	2	42
9	3	15
10	3	31
11	4	4
12	4	20
13	4	36
14	5	8
15	5	24
16	5	40
17	6	13
18	6	29
19	7	2
20	7	18
21	7	34
22	8	7
23	8	23
24	8	39
25	9	12

The operation is simple. We will repeat the procedure. First determine the amount of film that is missing. Thread the machine according to the edge number, then read the scale. Place the needle at the starting point, and with the turntable stationary, turn the record with the needle in the groove the number of turns which are indicated on the scale for that particular footage. The needle will thus be in the proper groove to insure synchronization.

More on Film Patches

THE following abstract from a paper prepared by Messrs. Crabtree and Ives of the Kodak Research Laboratories and read at the recent meeting of the S. M. P. E. at Toronto, is interesting in connection with the material on new film patches which appeared in these columns last month:

When two pieces of motion picture film bearing photographic sound records are spliced together end to end, an irregularity in the opacity is introduced at the point of junction. This irregularity is abrupt and causes a sudden change in the light transmitted by the film passing the light sensitive element of the sound reproducing device. Therefore unless some means is utilized for gradually masking off the entire width of the sound record in the vicinity of the splice, a foreign noise is heard when this part of the record is reproduced in a theatre.

One means of masking this area is by applying ink or black lacquer to the film with a brush in a triangular area covering at its widest part the splice in the sound film record. This brush work is slow and difficult to accomplish and the results obtained are often unsatisfactory.

A much simpler and quicker method of rendering the required area opaque has been devised. A patch made of thin black film is cut to the desired shape and perforated on one edge similarly to motion picture film for exact registration by means of a small mounting block. With a quantity of these patches on hand, the projectionist is able to repair quickly a broken sound record or to join two such films without introducing any noise into the record.

Under the heading "Film Patches" there appeared in the November issue of THE MOTION PICTURE PROJECTIONIST a reference to a suggestion of A. Caminetsky of Brooklyn, N. Y., for a new method of sound film patching. Mr. Caminetsky recommended the use of a gummed piece of paper of exactly the same size as the usual sound film patch. This method undoubtedly would eliminate any click as the film passed the aperture; but the objection to the method is that a paper patch is likely to peel and clog the film gate.

It is apparent that the method of Messrs. Crabtree and Ives described in the foregoing will meet with the same objections as that of Mr. Caminetsky. So far as can be determined from a description of the Crabtree-Ives process there is no avoiding the addition of an extra patch layer on top of the film. If the idea of the paper patch is rejected for fear of its peeling and clogging the gate, it seems reasonable to assume that this latest process must also be rejected for equally good reasons.

Both suggestions apparently were prompted by the idea of improving sound reproduction, yet neither guarantees the safety which is necessary with all film projection, sound or silent.



YOU'RE NOT SUPPOSED TO BE A FIREMAN

BUT—

When fire leaps out in the booth you are the only one to fight the red menace—

Your burns may be slight or again they may be mighty serious

Whatever danger occurs you must face it first and alone—

The wise projectionist boosts

SENTRY SAFETY CONTROL

REMEMBER

YOUR JOB IS TOO IMPORTANT TO WORRY ABOUT FIRE

Vacuum Tube Theory and Practice

By EDGAR MESSING

SOUND pictures placed the projectionist in a position where he was called upon suddenly to apply apparatus utterly foreign to his previous professional experience. He was asked to handle equipment about which he knew little or nothing, and it might be said that the facilities for acquiring in a short time the necessary knowledge to put over a first-class show were beyond his reach. Withal he was expected to handle this new equipment well and to project a show equally as good as the silent-picture standard. Further, we should remember that the projectionist must work under the handicap of knowing that even a small mistake will immediately manifest itself in poor screen results.

A good knowledge of this new apparatus is indispensable to the modern projectionist, who realizes fully that he can properly use only that equipment which he understands. If he has played with radio sets and displayed a lively interest in the progress of that art, he has a good start and the proper frame of mind with which to approach the problems of his sound picture apparatus.

The heart of sound reproducing apparatus is the vacuum tube. This marvel of science has made possible modern radio broadcasting, long distance telephony and sound pictures. New uses are found for it every day. It is not difficult to learn how it works, and to understand why it works is to know some interesting phases of electrical theory. It is the purpose of this series of papers, of which this is the first, to explain in detail how and why the vacuum tube performs as it does. Such explanation will necessarily involve the principles of amplifying apparatus in which we are primarily interested. Some of the material presented herein may seem at first sight to be fundamental and not directly related to vacuum tubes, but as the series progresses certain applications will be described which lead directly back to the elementary information which will be offered first.

The ordinary vacuum tube-triode, valve, audion, as it is variously known—consists of an evacuated glass bulb containing three elements—a filament, a grid, and a plate. The filament is heated by an electric current and emits electrons. These electrons pass to the plate through the grid. The potential variations on the grid control the number of electrons passing between the filament and the plate.

The Electron Theory

The basis of explanation is the electron theory and we shall go into this at some length before we come back to a consideration of the vacuum tube. According to this theory, all matter is fundamentally composed of electric charges, that is, everything that we know existing as liquid, solid, or gas is basically made up of one thing. Different kinds of matter differ in that they contain varying amounts of this one thing.

Matter may be chemically classified into various "elements"; in other words, a substance may be divided into its constituents and these parts broken up still further into their components until there remain substances that cannot be subdivided. No one of these final substances may resemble the original. As a simple example:—water we know to be composed of hydrogen and oxygen. Passing an electric current through water will cause it to break up into these two parts. Oxygen and hydrogen normally are gases and in no way resemble water. No matter what further operations may be applied to either of these we cannot subdivide them into

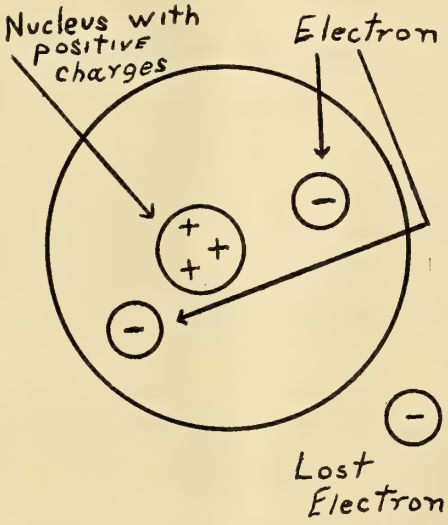


Figure 1—Representation of an atom with positive charge.

different substances. Such substances we call "elements," of which the more common ones are copper, iron, zinc and lead. The smallest part of these elements that are distinct as part of the element we call the *atom.*

Composition of the Atom

It has been established that every atom of matter is charged with minute particles of electricity, or *electrons.* The word "electron" is used to denote the smallest unit of electricity. We may for the sake of convenience picture it as a very small particle that carries a definite charge of electricity. We have come to apply the term to a very small particle of electricity that is "negative." Opposed to it is the "positive" electron, which is of equal value and which some now call *proton.* Both are charges of electricity, and it is because of certain characteristics peculiar to each and their marked behavior to each other and to themselves that we distinguish one as positive and the other as negative.

The law that these charges always follow is that like charges repel each other and unlike charges attract each other. Two electrons, therefore, will not remain in each other's company; while a proton and an electron will be attracted to each other. An electron, when separated from the atom to which it is attached, shows none of the properties of ordinary matter. It does not react chemically with other electrons to produce new substances, even though the elements from which they come may do so. An electron from the hydrogen atom is exactly similar to that from an atom of copper or zinc or tin, or any other substance.

Within the atom is a positive charge of electricity in the form of a nucleus, and close to it, in accordance with the fundamental law of unlike charges attracting each other, is an electron or a number of electrons, depending upon the atom of the particular element being considered. As previously stated, the difference between the elements lies in the number of charges in their atoms. Hydrogen, for example, has but one electron about its nucleus; copper has twenty-nine. Some substances have positive nuclei that will hold even more electrons.

Under normal conditions the atom has just enough electrons or negative bits of electricity to satisfy the positive nucleus. However, if something should happen to the atom and one electron be removed, conditions would no longer be normal—the atom has a positive charge that is unsatisfied and the whole atom is therefore considered positively charged. (Fig. 1.) Similarly if by one means or another an extra electron were introduced into the atom, there would be an unsatisfied negative charge and the atom would be considered negative. (Fig. 2.)

Under either of these conditions the atom has a new name: it is called an *ion,* and the process of adding or subtracting an electron is called *ionization.* In the filament of a vacuum tube we are continually removing electrons by the application of heat.

BY conductivity is meant the ability of a substance to pass an electric current. What an electric current is we shall presently see. In conducting solids there exist atomic systems in which the number of electrons, free or easily freed by the application of a potential, such as a battery, is comparatively large. These electrons we call free electrons, and while they may be relatively free from an atom, they cannot fly off from the substance itself, which is the condition that we want to secure in a vacuum tube. The force that holds the electron in the substance will be discussed later. The substance that do not have free or easily freed electrons are known as *insulators.*

A battery has the effect of being a source of electrons: at one terminal we may imagine a great many extra electrons

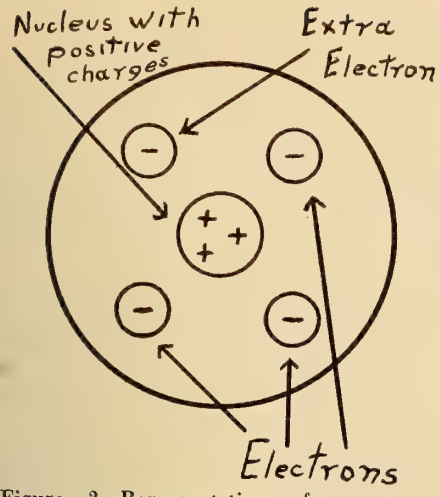


Figure 2—Representation of an atom with negative charge.

and at the other terminal a corresponding lack of electrons. When we connect the terminals of a battery to the ends of a body that has many free electrons, these are attracted to that terminal of the battery which lacks electrons; while at the other terminal where electrons are plentiful these stream off into the conducting substance to replace the free electrons. We now have a stream of electrons moving along the conductor from one terminal to the other, and we say that we have an electric current. *An electron in motion constitutes an electric current.*

The amount of electricity carried by one electron is immeasurably small. The number of electrons required to light a 100-watt lamp is on the order of ten billion billion each second, and this corresponds to a current of one ampere. This stream of electrons passing through the conductor will constantly be colliding with free atoms and creating additional free electrons, which in turn will stream along to knock off more electrons from other atoms. The speed with which the electron stream travels along a conductor is quite small, due to the close packing of the atoms and the resultant little free space in which the electrons may pick up speed. The vast number of collisions which ensue have the effect of slowing up the electrons, so that while they are whirling around at a high rate of speed, they may be drifting forward quite slowly.

Direction of Current Flow

It has been accepted as fact by most people that when the terminals of a battery are connected to some sort of conducting path, the direction of current flow is from the positive pole of the battery to the negative pole. But from what we have just reviewed we find that this is not so:—the electrons flow from that pole which has an excess of them (the negative), to the pole that lacks electrons (the positive), and that the current flow is *from negative to positive.* Therefore, when mention is made of current flowing from positive to negative, it must be remembered that what is actually happening is that electrons are flowing from negative to positive. In a vacuum tube the electrons that are thrown off the filament, which is made negative with respect to the plate, flow to the positive plate, and the current flow is from negative to positive.

It must not be construed by the reader that when we say electrons are passing along a conductor we mean that actual bits of material are passing. The atoms comprising the substance are practically fixed in position, although they do perform some irregular motions; but there is no movement of atoms progressively along the conductor, as there is a movement of electrons. We do not have a copper wire carrying itself from one terminal to another.

Resistance

We have considered the case of a conductor and the non-conductor, or insulator:—one has a great number of free electrons, and the other has none. Conductors differ in the number of free electrons which act to pass an electric current. The hindrance which conductors offer to the free progress of free electrons is called the *resistance* of the conductor. This quality differs in different metals. There are more free electrons in copper than in iron, and we therefore say that aluminum offers less resistance to electric current than does iron.

This value of resistance varies with the temperature of the conductor. At high enough temperatures insulators and non-conductors may act as conductors, while the resistance of conductors may be appreciably lessened. The reason for this is that heat gives energy to the electrons and they move faster and faster in their paths, so that the hold of the positive nucleus is weakened and there is possibility of more electrons being freed. Similarly, the passage of an electric current stirs up the electrons and the greater number of collisions that occur.

(To be Continued)

Progress in Color and Wide Film

THE most important items of progress within the past six months in the technical branches of the motion picture industry have been the extensive use of all-color sound pictures, or pictures with extensive color inserts, and several demonstrations of enlarged projected pictures by the use of film wider than 35 mm., according to the report of the Progress Committee of the S.M.P.E. submitted at the recent Fall Meeting of that organization.

Only two-color subtractive processes are at present in vogue and in one process extensively employed, two dye images are produced in a single layer film by imbibition. Although some three-color imbibition films have been prepared, they have not been publicly displayed.

Wide Film Advances

To date only one type of wide film has been put on the market, this being 70 mm. wide. Comment of the trade has been most enthusiastic with regard to its suitability for scenics and news events, but it is apparent that a new photographic technic is required to secure more pleasing perspective in the case of photoplays. Difficulties involved in the more universal adoption of the wide film are the present lack of standardization of size, the necessity for greater illumination at the projector aperture, and the prevention of film buckle.

Silent Films Total 5%

Studios in Hollywood are now producing only about 5 per cent of silent pictures. When it is considered that only one year ago the first dramatic pictures were shown before the Society, notably "The Singing Fool," the remarkable progress made since that time is apparent. There has been a steady improvement in the quality of sound reproduction, notably in the theatre, but in many cases the quality in the theatre falls far short of that which the film is capable of producing when it leaves the studio. Much still remains to be done in the way of improvement even with the best of recording. With the high quality music given by the modern radio receivers the public is realizing that the average theatre music is not equal in quality to that emanating from their radios at home.

Notable advances in studio technic have been (a) the tendency to use a minimum number of microphones and eliminate "mixing," (b) the silencing of cameras such as by means of insulating coverings thus permitting greater freedom of camera location, (c) the tendency to use more live studios so as to simulate more closely natural sounds, and (d) the non-simultaneous recording of scene and sound.

Improved Reproducers

A noteworthy advance in reproducers has been the introduction of the condensor or electrostatic reproducer consisting of a rubber diaphragm coated with aluminum foil and stretched across a metal grid. Apart from the high quality resulting, the reproducer occupies no more space than the average screen and can be raised and lowered just as easily.

No fundamental advances have been made in the field of stereoscopic motion pictures and although some of the sponsors claim that their wide film processes give stereoscopic effects, they are at the most pseudo-stereoscopic. A much higher order of relief is noticeable in many of the pictures in color.

Television Remote

Although color pictures have been televised during the past six months, the probability of television usurping the present motion picture in the immediate future appears to be very remote.

Pacent Service Stations

Besides its regular service facilities from Coast to Coast, through established representatives, seven new service depots of Pacent Reproducer Corporation, which will operate under the direct control of the New York office, are now functioning in New Orleans, Atlanta, Memphis, Oklahoma City, Albany, Denver and Des Moines. In each of these cities Pacent service men, controlled by headquarters in New York, are rendering inspection and maintenance service to exhibitors as well as emergency service when needed.

P. A. C. Luncheon to President Canavan

WITH practically every branch of the motion picture industry represented by one or more delegates, the Projection Advisory Council luncheon tendered President William F. Canavan of the I. A. T. S. E. & M. P. M. O. U. at the Hotel Astor, New York City, on November 14th was by far the most successful and significant gathering in the interest of projection and projectionists that has ever been held. As a matter of fact, it was the first gathering on record strictly in the interest of projection at which all branches of the industry were represented. More than 175 people were present, and among this number were studio technicians, stagehands, executives, managers, projectionists, cinematographers, manufacturers, newspapermen and labor leaders—all gathered together for one purpose and that to better projection.

Local Unions of the I. A. themselves set the pace for the meeting, with delegates from more than 20 Locals in nine different states being present. Delegations from Boston, Newark, Rochester, New York City, Schenectady, Providence, New Haven, Jersey City, Atlantic City, Philadelphia, Washington, D. C.; Scranton, Easton, and many other cities were present. Identities were ignored in the seating arrangements, thus an entente cordiale was established at once that went far to insure the success of the affair.

President Canavan's Address

Assembling for luncheon at 12:30 P. M. sharp, the meeting continued until well after 4 o'clock, during which period there wasn't a dull moment. It can be said that the luncheon was excellent, but this might publicly be said to be a minor detail (that is, *publicly*). After cigars and demi tasse, the gathering settled down to the business at hand, of which there seemed to be so much that only a fraction of the potential discussion surging in the breasts of those present could be invited.



William F. Canavan

The highlight of the afternoon was President Canavan's address, a complete transcript of which is appended hereto. After reading a prepared address in which he cited the growth of the motion picture industry with its attendant increasing responsibilities for the projectionists, President Canavan launched into an extemporaneous talk in which he stressed the desire and the ability of the projectionist to do quality work, the injustice of the many critical comments made regarding projection work, and the necessity under existing conditions for the projectionist to devote more and more of his leisure time to the study of and practice with his equipment in order that he might turn in the best possible performance.

President Canavan emphasized the fact that, within his experience with the American labor movement, he knew of "no group of wage-earners which has given as much time to the scientific consideration of their work as motion picture projectionists."

Following President Canavan's address, toastmaster Lester B. Isaac, Supervisor of Projection for Loew Theatres, Inc., and President of the P. A. C., introduced Sam Kaplan, President of Local 306. Mr. Kaplan cited the progress made by the craft in the last two years and complimented the officers of the Council for their fine work. He added that the Council might expect the active cooperation of the entire membership of Local Union 306 in all its endeavors and stated that he felt sure he might speak similarly for every other Local Union in the Alliance. The manner in which the projectionist mastered the intricacies of sound picture reproduction, said Mr. Kaplan, was the best index as to the worth of the craft and of its ability to produce quality work consistently.

The Local 306 leader disclosed the fact that when he entered the luncheon room he was amazed at the number of representative guests who were in attendance, adding that had anyone suggested the possibility of such a meeting purely in the interest of projection prior to the very day it happened, he would have been unable to believe it possible. He closed his remarks by suggesting that now that the "ball had started rolling in the right direction, let us keep it going."

Following the introduction by Mr. Isaac of a number of well-known guests present, Charles F. Eichhorn, Vice-President of Local Union 306, opened the forum for discussion. Among the topics which came up for discussion during the forum was the effect of faulty recording on sound reproduction; the radio campaign of Boston

(*Continued on page* 34)



General view of dining room at P. A. C. luncheon to Pres. Canavan of I. A.

Elementary Optics

BY SAMUEL BAGNO

WHEN light is transmitted from one medium to another several things can happen to it: the light may be reflected from the second medium; it may be dispersed (reflected in many different directions); refracted, or polarized. The study of just what happens under these various conditions is known as the science of optics. In order to visualize just what does happen under these conditions, it is convenient to consider the light traveling from the source in one direction only. This beam of light is generally represented by an arrow.

The diagram in Fig. 1 shows a beam of light from a source passing through a piece of glass and striking a piece of white paper. The light, when hitting the glass, is partly reflected and partly transmitted through the surface of the glass. The



Types of Lenses

light that is transmitted through the glass is bent out of its original path. This is termed "refraction."

Reflection

By far the simplest of all light effects is reflection. The law for reflection involves no experimental constants, but merely states and means that the angle of reflection is equal to the angle of incidence. This is illustrated in Figure 2. When this surface is flat we get an ordinary mirror; but when the surface is curved, we get many peculiar effects. It is possible to make an optical system for a camera, a projector, a telescope, and many other things, with a set of reflectors.

Supposing we take a part of a hollow silvered ball (Fig. 3), and place an object in front of the curved portion. In this figure we will consider the object as an arrow. If we take two points off this arrow, and take two rays of light from each point and trace them to the mirror and back, we will find that all the rays striking the mirror from any point in the object will intersect *at some one point* after leaving the mirror. If a white piece of paper be placed at this intersection, the

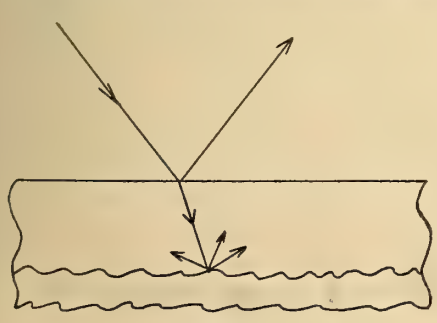


Figure 1

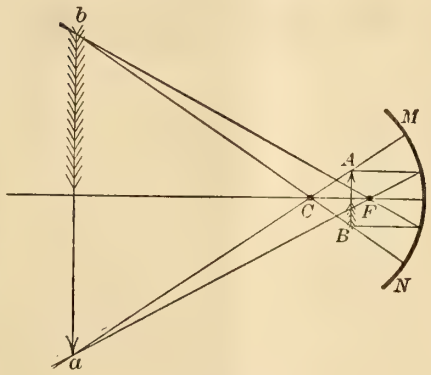


Figure 3

image, or picture of the object, will be seen on that paper.

Another important application of a curved mirror is that of a mirror so designed as to reflect all the rays of light from point source parallel to each other. The slope at every point must be such as to accomplish this purpose. Such a mirror is placed in back of the arc on a motion picture projector, and also in a beam searchlight. If it were possible to build a perfect parabolic reflector, a beam of

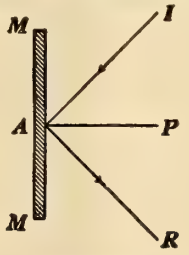


Figure 2

light could go on almost endlessly without losing much of its original intensity. Such a reflector is pictured in Fig. 4.

Fundamentals

Before we consider the laws of *refraction* it would be better to review a few fundamental definitions. These are:

1. An angle is the entire portion of space between two intersecting lines.
2. The entire space around any point is divided into 360°.
3. A right angle is one-quarter of the space around any point, thus: (¼ of 360°, or 90°).
4. A perpendicular to a line is a line at right angles to it.
5. A circular arc is a portion of a circle. This is measured in degrees and is equal numerically to the angle intercepted by two lines from the center of a circle to the extremities of a circular arc.
6. The *sine* of an angle is perpendicular dropped from one end of the arc on to the more radius at the other end of the arc, divided by the length of the radius. This is shown in Fig. 5.
7. The angle of incidence of a ray of light is the angle formed by the incident ray and the normal (or perpendicular), to the surface at the point at which the ray strikes it. This is pictured in Fig. 6.
8. The angle of refraction likewise is the angle formed by the refracted light *and* the perpendicular *to* the surface through which the ray of light emanates. Also shown in Fig. 6.

It was not until the latter part of the eighteenth century that a general law explaining all refraction was formulated. Before this time the manufacture of all lens systems was merely a matter of experiment. As far back as the thirteenth century Bacon predicted the application of the lens systems we have today—the telescopes, microscopes, and even the magic lanterns. However, not until the law of

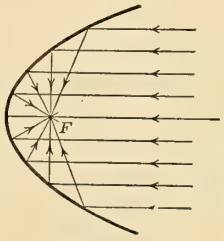


Figure 4

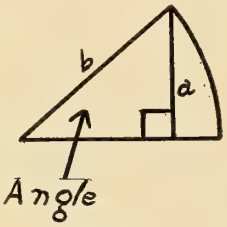


Figure 5

refraction was formulated some 500 years later were these instruments made practicable.

Law of Refraction

This law, while extremely important, is one of the simplest: It states that the sine of the angle of incidence *divided* by the sine of the angle of refraction, is a *constant*. This constant can be determined for a flat glass plate by observing how a ray of light, striking slantingly against the surface of the glass, is bent in passing through it. Once this constant is determined, the design of any lens system to accomplish any desired purpose can be determined. Lenses are generally built with spherical faces in order to facilitate the grinding process. Fortunately this type of lens lends itself to almost any desired purpose.

The principle of tracing several rays of light is used in calculating every type of lens system. The simplest and perhaps the most useful optical system is the cam-

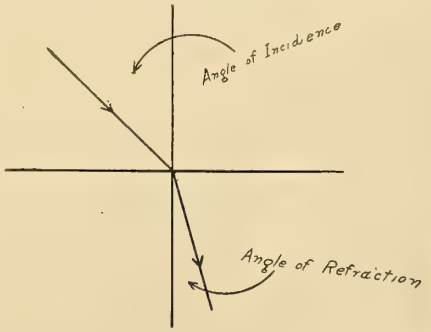


Figure 6

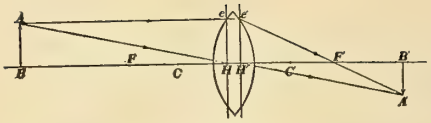


Figure 7

era. The principle of this instrument is shown in Fig. 7.

The camera is the essence of the projector and of the optical system for the sound track. By means of it the image of the film is concentrated on the screen, or the image of a mechanical slit is concentrated on the film.

Of particular interest is the fact that rays of light of different colors are bent differently when passing through the same piece of glass. A violet ray is bent the most, and the other colors of the spectrum are bent according to the way they follow violet in the spectrum:—blue, green, yellow, orange, and red. This is known as *chromatic aberration.*

However, since different kinds of glass possess this property in different degrees, this condition may be compensated for by putting a hollow and a bulging lens together. The image resulting from this combination is not distorted by the color effects of the light.

Standard Nomenclature

(The following glossary of technical terms used in the motion picture industry was formulated by an S.M.P.E. committee and adopted as standard by that organization. Trans. Vol. XIII, No. 37.)

A

ACTINIC—Having the property, possessed especially by the shorter wave lengths of the spectrum, of effecting chemical changes as in photography.

Acoustic Flat—Set Flat treated to secure sound absorption.

Additive Process—Color processes in which various hues are obtained by the addition of two or more of the spectral regions comprising white light.

Alternating Current—Current which flows first in one direction and then the reverse, due to the regularly recurring alternation of potential of the generator.

Ampere—The unit of measure of electrical current.

Amplification—The ratio of the voltage or current output to voltage or current input respectively.

Amplification Factor—The amplification factor of a three-electrode vacuum tube is the ratio of the change in static plate potential to an infinitesimal change in that static grid potential, all other variables remaining constant.

Amplitude—In any vibratory motion, the extent of movement from the mean position to the extreme.

Angle of Incidence—The angle which an incident ray of light forms with the normal to the surface.

Angle of Reflection—The angle which a reflected ray of light forms with the normal to a surface.

Aperture—The opening in the aperture plate at which each individual picture is situated during exposure, printing or projection, respectively.

Aperture Plate—In a motion picture projector, printer, or camera, a plate of metal containing the actual aperture opening.

Arc—A column of very hot light-emitting gas, carrying an electric current sustaining this condition.

Attenuation—The inverse of gain measured in the same units as gain.

B

Back-Focus—The distance from the principal focus of a lens to its nearest face.

Baffle Blanket—Felt sheets covered on both sides with muslin and distributed about the set to make it acoustically satisfactory for sound recording.

Beat—Interference between two wave trains resulting in alternate reinforcement and destruction of the one by the other.

Bel—Ten decibels.

Blooping Patch—A triangular black section introduced over a splice on the positive sound track, to prevent the noise which the splice would otherwise cause during reproduction. The patch effects a relatively gradual diminuation in the transmitted light, followed by gradual restoration to the original value. The frequency of the diaphragm movement thus caused being below the threshold of audibility, no sound is heard. The patch may be applied by stencilling with black lacquer, or may be a triangle of black paper or film cemented on the track.

Brightness of a Surface—The luminous intensity per unit of projected area.

Bullet-type Microphone—A condenser microphone and microphone amplifier mounted in a small case.

Business—Action by the player; e.g., business of shutting door.

C

Camera Booth—Sound-proof inclosure for cameras employed to prevent camera noises from interfering with recorded sounds.

Camera Marker—The device for marking the picture negative.

Camera Motor—A motor for driving a motion picture camera.

Candlepower—The luminous intensity expressed in candles.

Change-Over—In projection, the act of changing from one projector to another preferable without interrupting the continuity of projection.

Cinè—A prefix used in description of the motion picture art or apparatus.

Close-up—Scene or action taken with the character close to the camera.

Condenser—The lens combination which refracts the diverging rays of the luminant into the projection lens.

Collecting Lens—The lens of the condenser nearest the light source.

Converging Lens—The lens nearest the objective.

Center Lens—The lens of a three lens combination lying between the collecting lens and the converging lens.

Contrast—The ratio of the highest to the lowest value of transmission. The range of tones in a negative or print.

Cooling Plate—A shield or baffle, composed of one or more plates, mounted between the light source and the mechanism, and usually attached to the latter but spaced therefrom, to prevent overheating the mechanism.

Cut-back—Scenes which are returns to previous action.

Cut-in—Anything inserted in a scene which breaks its continuity.

Cutting—Editing a picture by eliminating unsuitable subject matter therefrom.

D

Developing—Chemically treating exposed film to make the latent image visible.

Diffuse Density—The value of density in which the total transmitted intensity is measured. (This value of density is applicable to contact printing relations.)

Direct Current—An uniform flow of electric current in one direction as from a battery or direct current generator.

Director—The person who superintends the actual production of the motion picture.

Dissolve—The gradual transition of one scene into another.

Distortion (of Sound)—Modification of sound caused by the means employed in its recording and reproduction.

Double Exposure—The exposure of a negative film in a camera twice before development.

Douser—The fire-proof shutter usually mounted on the lamp house of a motion picture projector or stereopticon by means of which the light may be intercepted before it reaches the film or slide.

Dubbing—The re-recording by electrical means of a sound record or portion thereof. The operation may involve transference from film to wax, wax to wax, or wax to film. Dubbing is resorted to for editorial purposes, for changing volume levels, and for changing the recording medium.

E

Effective Aperture—The largest diameter of a lens available under the conditions considered.

Electrical Filter—A network of electric circuit elements designed to pass or suppress one or more bands of frequencies.

Equivalent Focal Length—The equivalent focal length of a combination of lenses is equal to the focal length of a simple thin lens which will give an image of a distance object of the same size as does the combination lens.

Exciter Lamp—The light source used in reproducing sound from a film.

Exposure—(1) The product of time and the illumination incident upon the

(Continued on page 40)

Disc Pick-up Intricate Process

VICTOR L. OSGOOD

(Copyright, 1929, by Victor L. Osgood)

THE method of recording music on a wax cylinder or disc, to be later reproduced, is quite common knowledge because of the simplicity of the apparatus involved and also because the phonograph has been in use for a full generation. But the process of reproducing that recorded music through a speaker is not only a more complicated matter, but is a much newer invention, considerably less understood, due to its electrical nature and lack of explanation.

It may be added here that the orthodox type of pick-up (as these units are called), is today still considerably removed from the perfected state. This applies especially to permanence and efficiency, though we are not primarily concerned with the latter, for what radio apparatus is efficient? If we get enough energy from the pick-up to compare favorably with that delivered by the radio frequency amplifier, on a loud signal, to the audio system, we are going to have plenty of signal strength from the loud speaker.

Tubes Easily Overloaded

An average potential of one volt generated by the pick-up will produce overloading on a single tube, and is the limit that the first stage audio tube will stand without overloading unless it is equipped with a high plate and grid voltage.

Quality of reproduction is a more vital factor than efficiency. To have all frequencies generate the same value of voltage is the ideal condition, when used with an amplifier and speaker that do not have frequency characteristics. But amplifiers and speakers do have frequency characteristics and consequently the ideal pick-up is one that makes up for the discrepancies of the succeeding apparatus.

However, the ideal condition is seldom attained, and if it be approached in practice, the remaining deficiencies are overlooked by the human ear. Therefore, a pick-up, to be considered very good, must be sensitive enough to supply about ¾ of a volt in the region of a thousand cycles, to have no sharp resonamce peaks, and have a fairly high and low cutoff, say 4,000 cycles and 60 cycles, respectively. It will also be better if it has a rising characteristic below 250 cycles, because record manufacturers do not cut these frequencies with their proper relative amplitude, due to lack of space between grooves. The fact that amplifiers have a drop in amplification at those low frequencies adds

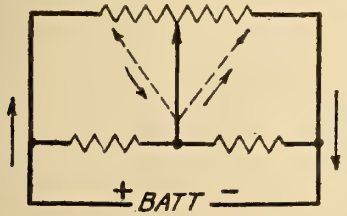


Figure 2

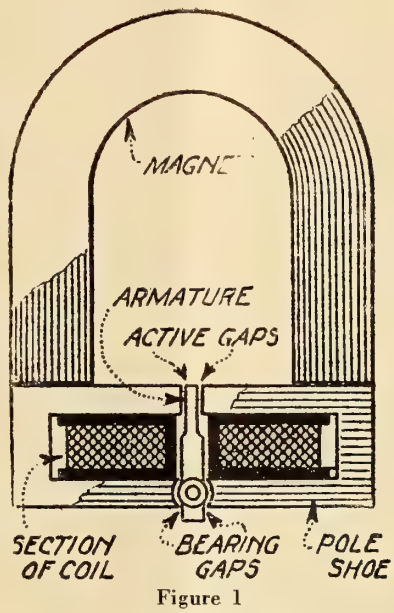


Figure 1

to the desirability of the rising characteristic.

The curve should taper off, too, at about 2,500 cycles, because the needle scratch region is entered at that point and the scratch is very objectionable if not filtered. And the filtering merely tapers off the high end, which characteristic might just as well be incorporated in the pick-up design.

Stopping Needle Scratch

Another very important point in the design of a pick-up is the mechanical impedance of the needle point. Too stiff a needle will result in excessive side wear on the record grooves and will even break them through at times. This, of course, results in impaired reproduction and, later on, a ruined record.

Permanence, mentioned before, is much more important than we might at first suppose. In this respect, aside from wear and improper handling, there are two main vulnerable points: (1) the strength of the magnet, and (2) the life of the rubber bearings and dampers. If a pick-up when purchased, is considered as being a permanent installation without troubles, a certain amount of disappointment must follow if the magnetic structure is not properly designed or if the armature is mounted on rubber bearings and adjusted with rubber dampers.

Structure of Air Gap

The magnetic structure is mentioned because the writer has had occasion to examine a large number of different makes during the last year and has found that the majority do not come up to certain specifications determined emphatically by the Bureau of Standards for maintaining life. There is a gradual decrease of field strength in the magnet, with a corresponding decrease of response in the tiny generator it excites, this decrease being quite heavy at first and diminishing gradually. That is, the less the strength of the magnet. the less the demagnetizing force.

The Bureau of Standards states that, in order that cobalt steel retain its magnetic field indefinitely, the equivalent air gap (summed up from the several gaps) must be so proportioned that:

Length of magnet (cross section of mag.) x cross section of gap (length of gap) is equal to or greater than 35, assuming that the iron structure has sufficient cross section to carry the field without saturating. In the case of tungsten steel, this product must equal or be greater than seventy. This fact largely accounts for cobalt being used so widely, because it is difficult, in the usual type of pick-up mechanism, to have an equivalent gap that will satisfy the tungsten equation without introducing some other objectionable features.

Needle Upsets Balance

Figure 1 shows both the theory and practice that has been used in the past for the better grades of pick-ups, the only difference in the various makes being in the proportioning of parts and gaps.

This structure is a "bridge" circuit, an exact duplicate, magnetically, of the electrical Wheatstone bridge. The needle motion upsets the balanced condition of the bridge, in degrees and at frequencies corresponding to the amplitude and frequency, respectively, of the recorded sound.

Since, in a static condition, the magnetic field is absent in the armature, all the flux flows across the gaps at each end of the armature without any of it threading the coil. But a movement to either side of the static position will result in some flux in the armature, its polarity being determined by the direction of armature displacement and its amount by the amplitude of motion.

The fact that alternating flux is produced in the armature by a mechanical movement back and forth each side of the balanced position may be better understood by an examination of Figure 2, which is a schematic diagram of an equivalent electrical circuit. Here the battery corresponds to the magnet, the resistors to the air gaps and the movable contact arm to the armature. Anyone only slightly familiar with electricity will readily see why current flows in the direction shown by the arrows in the respective positions of the contact arm.

The coil is wound over the armature on a spool which does not make mechanical contact with any of the moving parts, as this would introduce distortion from friction, or, if the pressure were very heavy, the mechanical impedance of the needle goes up excessively, eliminating high and low frequencies and causing extreme wear on the record grooves.

Since rubber is an impermanent material, the gaps cannot be adjusted so that the motion of the armature includes more than a small percentage of them. It is obvious, in Figure 2, that the more the

(Continued on page 32)

As The EDITOR Sees IT

¶Improved Reproduction Facilities

SOUND pictures have improved tremendously since their introduction on a commercial basis, but the quality of many sound pictures as presented in not a few theatres today is anything but what it should be. Improvements have been noted in recording and reproduction technique, but little advance can be credited to the accessories for good recording and reproduction. The projector still is loaded down with many extra "gadgets" which in many cases serve only to harass the projectionist in his efforts to put on a good show. We often come across a commentary on the ideal type of speaker, but can anyone prove that the present sound picture horn is but a step advanced over the early speakers in its reproducing quality?

Then there is the old, old complaint on the score of good screen results. Screen manufacturers are bending every effort to solve this highly important problem of screen light values, but they still have a long way to travel before their task is ended—our opinion being that the present positioning of the horns will prove a stumbling block in this respect for quite some time to come. Screen results in many theatres today are very poor when one recalls the progress that was being made in this respect before the coming of sound. Sound with pictures is all very well, but we must have a picture which is bearable to look at.

We all are one in lauding the progress that is being made in the development of the sound picture art, but we often wonder if it wouldn't be just a bit better to detach a force to act as a rear guard the while this grand and glorious army of electrical entertainment technicians pushes onward to win new battles in the realm of the scientific unknown.

¶P.A.C. Luncheon in New York

EASILY the outstanding development in projection circles within the past month, and for many months past, was the luncheon tendered President William F. Canavan of the I. A. T. S. E. by the Projection Advisory Council on November 14th at the Hotel Astor in New York City. The affair was a grand success in itself, but the importance of the gathering from a projection viewpoint may not be judged fairly by any social yardstick. To anyone who has followed closely the battles of the past for recognition of the importance of projection and the projectionist in the scheme of things in the motion picture theatre, this affair was a revelation—a revelation of the new prestige which has been won by the craft for its splendid work of the past two years. Anyone who had proposed such an event one year ago would have been laughed at; yet in a mere twelve months such a gathering passed beyond the stage of possibility and became an actuality.

Gathered together in one room were more than 175 friends of better projection — executives, managers, engineers, newspapermen, cinematographers, stagehands, manufacturers, labor leaders, and projectionists. The luncheon was arranged ostensibly for the purpose of providing the press with an opportunity for becoming better acquainted with the problems of projection, with President Canavan cheerfully accepting the invitation to act as the principal liaison officer. While the press conference was necessarily curtailed, it may be said that the luncheon, even without a press conference, accomplished far more than its sponsors hoped for. A few problems were discussed, indeed, but it is certain that the affair did more to promote a better understanding between the various branches of the industry represented in the room than would a whole afternoon session devoted to a discussion of problems.

Incidentally, one of our pet contentions was sustained by the affair, for there before our startled gaze were the *accredited delegates* of nearly a score of Local Unions, officially designated by their fellow members to represent them at the meeting. This interest on the part of the Local Unions in the *quality* as well as the *quantity* of work done by their members was extremely cheering. And we feel certain that not a single delegate to the meeting can honestly say that his trip to New York was not time well-spent.

There were many other highlights of the gathering, too numerous to mention here. Elsewhere in this issue there appears a detailed account of the luncheon, with a complete list of those attending. The list of guests is impressive, judged from any standpoint. The affair was provocative of much good fellowship and not a little interchange of valuable information. It reflects much credit on its sponsors, particularly on P. A. McGuire of the International Projector Corp., who worked long and hard to insure the success of the affair. Mr. McGuire was ably assisted by many co-workers, chief of whom was Charles F. Eichhorn, Vice-President of Local Union 306.

¶More on Wide Film

A SHORT while ago there was offered in a Broadway theatre the first public presentation of a new motion picture film size, which we term "wide film," the while disdaining the fanciful names which have been appended to the few systems which have already been shown or will be shown within the next few months. Following this first public showing, the uproar which was occasioned by it seems to have died away to a whisper. But let us not check this venture off as "just another one of those things," the latest failure in a series of technical developments which are accredited as being absolutely "the last word." For we have not heard the last word on this important matter, not by far.

The various companies interested in a wide film process are merely marking time, devoting their time to improving this and that feature of their equipment and strengthening their lines in general. The most encouraging aspect of this new development is, as we stated previously, the fact that there is much work and little talk, the latter being the usual accompaniment to all too many "last word" disclosures in the scientific field. It is understood that Fox plans to introduce its Grandeur system to the general exhibition field via an installation in the Roxy Theatre (N. Y.), not later than next February. RCA has formally announced its acquisition of the Spoor-Berggren process rights and is planning an intensive campaign all along the line. Little or nothing has been heard from Paramount on its Magnafilm, but it is safe to assume that they are working feverishly to perfect the system.

When wide film does begin to catch on it will probably follow the same path as did sound pictures—it will arrive with little fanfare, take hold suddenly and be here before we quite know just how it all happened. Information on the different processes, which we have promised for these columns, is impossible to get, so closely are the various owners guarding their secrets. As we stated before, projectionists need have no great concern about their responsibilities with this new equipment. Increased care and watchfulness is about all this new development will demand of the projectionist.

Everyday Science

Carbon Dioxide

A PRODUCT of burning. When any fuel, such as coal, gas, oil, or wood, burns, it sends forth gases into the surrounding atmosphere. These gases, like air, are invisible, and were unknown to us for a long time. The chief gas formed by burning substance is called carbon dioxide (CO_2) because it is composed of one part carbon and two parts of oxygen. This gas has the distinction of being the most widely distributed gaseous compound of the entire world; it is found in the ocean depth and on the mountain heights, in brilliantly lighted rooms, and most abundantly in manufacturing towns where factory chimneys constantly pour forth hot gases and smoke.

Wood and coal, and in fact all animal and vegetable matter, contain carbon and when these substances burn or decay the carbon in them unites with oxygen and forms carbon dioxide.

The food which we eat is either animal or vegetable, and it is made ready for bodily use by a slow process of burning within the body; carbon dioxide accompanies this bodily burning of food just as it accompanies the fires with which we are more familiar. The carbon dioxide thus produced within the body escapes into the atmosphere with the breath.

We see that the source of carbon dioxide is practically inexhaustible, coming as it does from every stove, furnace, and car and further with every breath of a living organism.

Danger to Health

When carbon dioxide occurs in large quantities, it is dangerous to health, because it interferes with normal breathing, lessening the escape of the waste matter through the breath and preventing the access to the lungs of the oxygen necessary for life. Carbon dioxide is not poisonous, but it cuts off the supply of oxygen, just as water cuts it off from a drowning man.

Since every man, woman and child constantly breaths forth carbon dioxide, the danger is overcrowded rooms is great, and proper ventilation is of vital importance.

Motors' Hum Lights Landing Field

No longer will it be necessary to keep airplane landing fields brilliantly lighted all night when a new invention, only recently demonstrated, is perfected to the point of being manufactured in quantity. The noise made by the hum of an airplane 1,000 feet in the air closed the switch that lighted a bank of flood lights at a Pennsylvania aviation field in the first demonstration of the sound sensitive automatic lighting apparatus developed by an electrical research engineer.

The device uses the drone of the airplane to control electric energy. From a tiny current at first this controlled energy is increased in power by amplifiers until it is strong enough to throw a good sized lighting switch.

A loud-speaker operated reversely is the "ear" of the mechanism. Laid on its back it gives the apparatus a directive effect with reference to noises from above. A microphone completes the auditory section. Passing through several amplifiers the impulse then passes through the time-light relay, the last step before the current automatically throws the lighting switch.

The switch locks automatically and the lights remain on until the switch is thrown by a field attendant.

Instability of the Air

We are usually not conscious of the air around us, but sometimes we realize that the air is heavy, while at other times we feel the bracing effect of the atmosphere. We live in an ocean of air as truly as fish inhabit an ocean of water. If you have ever been at the seashore you know that the ocean is never still for a second; sometimes the waves surge back and forth in angry fury, at other times the waves glide gently in to the shore and the surface is as smooth as glass; but we know that there is perpetual motion of the water even when the ocean is in its gentlest moods.

Generally our atmosphere is quiet, and we are utterly unconscious of it; at other times we are painfully aware of it, because of its furious winds. Then again we are oppressed by it because of the vast quantity of vapor which it holds in the form of fog, or mist. The atmosphere around us is as restless and varying as is the water of the sea.

The air at the top of a high tower is very different from the air at the base of the tower. Not only does the atmosphere vary greatly at different altitdues, but it varies at the same place from time to time, at one period being heavy and raw, at another being fresh and invigorating.

Winds, temperature, and humidity all have a share in determining atmospheric conditions, and no one of these plays a small part.

Long-Lived Lamps Too Expensive to Consumer

AN electric lamp that will give light for years is too expensive for a customer to buy. Occasionally a lamp built for a thousand hours' service will burn for years, as was the case recently discovered in New York where a dealer reported that a tungsten lamp had given service for more than nine years.

As a matter of fact, manufacturers could make electric lamps to burn nine years or much longer, but the cost of operating such lamps would be excessive. Lamps are designed to give approximately one thousand hours of continuous light with a minimum consumption of electricity for any given amount of light. To make a lamp last longer it is necessary to put more material into the filament and it then requires more current to heat it to the required temperature.

$10 Additional Cost

For example: A customer might save 5 cents per lamp by buying a carbon filament instead of a modern tungsten filament lamp, but the cost of operating it would be much more. At 10 cents a kilowatt hour it costs a customer $5 to burn a 50-watt tungsten lamp one thousand hours, and it would cost approximately $15 to burn a carbon filament lamp giving the same amount of illumination. In other words, to save 5 cents, the customer would be obliged to spend $10 more to get the same amount of illumination.

Moving Strips of Fabric Weighed Electrically to Test Uniformity

A recent development in automatic electric weighing has made it possible to weigh a continuous web of paper, or other material, as it passes through the mechanism, which does not touch the material weighed.

Tuned Radio Circuit

The principles underlying this process are those of the tuned radio circuit. The web of material passes between two parallel metal plates which act as a condenser in the receiving circuit. Variations in the weight of the web change the capacity of the condenser and affect the response of the circuit to a wave of controlled frequency. These variations are indicated on a meter, and may also be used to operate machine controls by suitable relays.

The new weighing process is said to be of notable value in maintaining uniformity in the weight of paper.

Cause of Mouth Breathing

Some people find it difficult to breathe through the nostrils on account of growths, called adenoids, in the nose. If you have a tendency toward mouth breathing, let a physician examine your nose and throat.

Adenoids not only obstruct breathing and weaken the whole system through lack of adequate air, but they also press upon the blood vessels and nerves of the head and interfere with normal brain development. Moreover, they interfere in many cases with the hearing, and in general hinder activity and growth.

Affects Early Development

The removal of adenoids is simple, and carries with it only temporary pain and no danger. Some physicians claim that the growths disappear in later years, but even if that is true, the physical and mental development of earlier years is lost, and the person is backward in the struggle for life and achievement.

Gas Now Used as a Refrigerant

Gas—long used for lighting only, but which can now be used wherever heat is necessary in the home or industry—has entered the new field of refrigeration. Gas-fired refrigerators are now on the market which utilize gas fuel for expanding the refrigerant, which is ammonia or some other gas of like properties.

The principal points claimed for gas-fired refrigeration are absence of moving parts, quietness of operation and low cost of service.

Efficient Sound Projection

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

PERSONALLY I have watched hundreds of projectionists putting on a show. Some were good, some average, and a few poor. One can usually tell if the show is going to be a "flop" with sound and projection and general running routine. A performance can be rehearsed too much, the same as a prize fighter can do too much training. He is overconfident and becomes careless, because of mechanical routine. I have seen many projectionists work sixty hours without sleep, installing equipment in a new theatre, and yet on opening night run the show to the entire satisfaction of everyone concerned. But now it is entirely different. Sound pictures require greater attention.

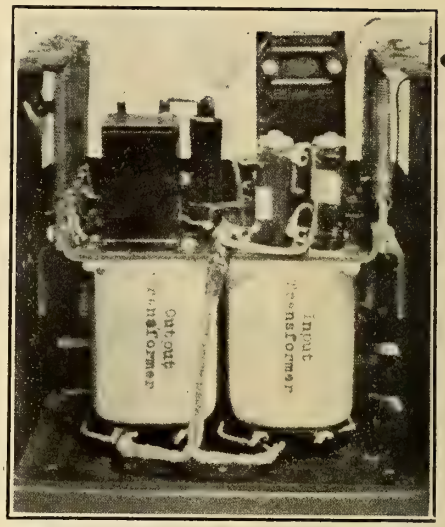
Projectionists and managers have been in the habit of waiting until the last minute before rehearsing premiers, and have worked a few nights and days up to the opening hour of the show. *This must be discontinued.* Projectionists must step into the projection room on opening nights well rested and in good shape—otherwise the performance may be a complete "flop."

All sound projector systems are provided with a means for controlling the volume of the sound—a fader. The face of the fader box is divided, one side being red with fifteen numbers, and the other side white with fifteen numbers, each number corresponding to one resistance coil, so that when the pointer is retarded or advanced one number it has cut-out or cut-in one of the resistance coils. It is imperative that the fader contacts be kept perfectly clean at all times.

Let us analyze this unit of equipment as shown in the accompanying illustration. Switch No. 1 is for the purpose of cutting-out the fader in case of trouble. Switch No. 2 is used when three sound projectors are equipped with sound. No. 3 fader contacts are connected to 30 short coils of resistance wire in a circle around a metal disc (No. 4). Arm No. 5 receives current from disc No. 4 through contact No. 7 to the resistance coil contact, with resistance in series with the pick-up circuit. No. 6 represents the locating arm positions and indentations. The locating arm carries no current, but acts only as a semi-lock to hold the fader arm in position. No. 9 is a cast iron frame which has a bearing for the fader knob shaft and other working parts. No. 8 identifies rod clamps, whereby auxiliary dummy faders may be connected.

The terminal input blocks will be found at the lower part of the fader. The projector pick-up circuits are connected to the input of the fader. The switching panel to change from disc to film is located either above the master fader or above the film pick-up amplifier on the universal base.

Note the output terminal block. The output leads are connected to the first stage of amplification. The factor is always located between the projector pick-up circuit and the first stage of amplification.



Rear view of the W. E. 49-A amplifier, showing input and output transformers; also grid-biasing resistors.

In case of trouble with the fader, cut-out the fader by using switch No. 1. The volume may be either increased or decreased by the potentiometer on the main amplifier.

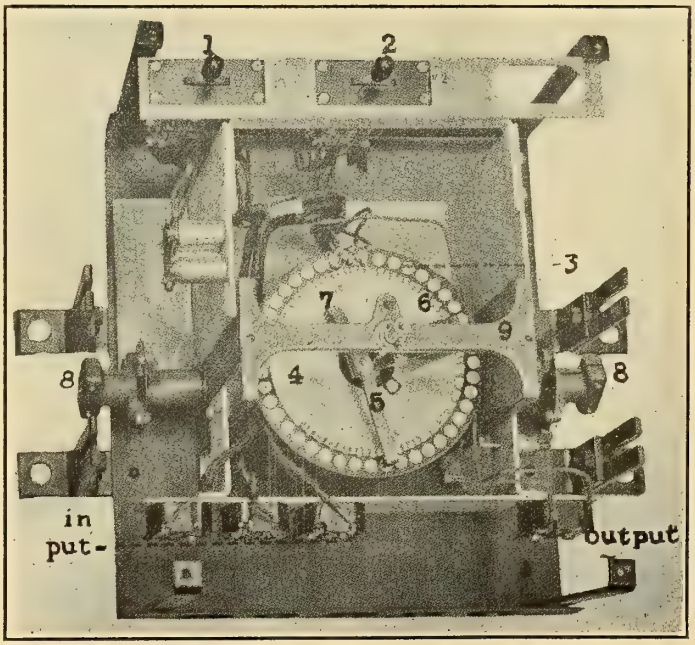
Western Electric 49-A Amplifier

The 49-A amplifier is designed to bring the level of the electrical counterpart of the film sound record up substantially to the same energy value as that obtained from the magnetic coils of the disc reproducer. Note the accompanying schematic diagram of the 49-A amplifier.

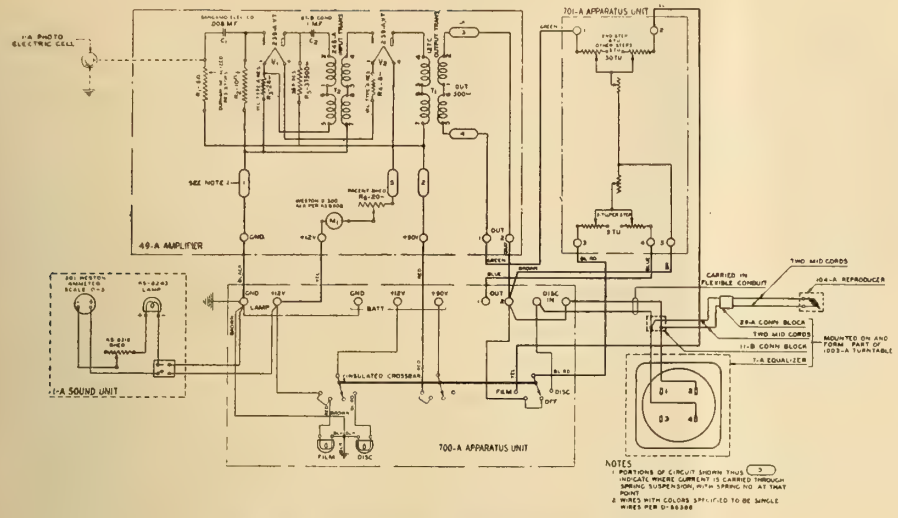
The current for the tube filaments is supplied from a 12-volt source, and is measured by a series milliammeter. The value of this current is adjusted to 270 milliamperes by a 20-ohm rheostat. The current flows through the milliammeter, KS-6208, R-6 20-ohm rheostat, through 239-A vacuum tube filament No. 2, through R-4, an .8-ohm grid biasing resistor, through the filament of 239-A vacuum tube No. 1, through R-3, a 24-ohm biasing resistor, and back to the negative terminal of the battery supply.

In order to establish a definite ground potential on the unit, the negative side of the battery line is connected to a common ground. The plate voltage is taken from a 90-volt supply. This is reduced to 45 volts by resistor R-5, which has a resistance of 37,500 ohms, connected to the plate of vacuum tube No. 1. The plate potential of the second tube is supplied through the primary winding of the output transformer, T-1, and since the resistance of the transformer winding is relatively low, the effective voltage applied to the second tube is approximately 90 volts.

The necessary negative grid potential for the first vacuum tube is produced by taking a drop off the 24-ohm series filament resistor connected in the negative side of the No. 1 tube filament. The potential thus taken off is approximately 6½ volts negative. The grid bias for the No. 2 tube is produced by tapping off the voltage drop produced by a filament current flowing through the 24-ohm series resistance, the 24-ohm resistance of the No. 1 tube filament, and the 8-ohm series resistance connected in the negative side of the No. 2 tube filament. A negative drop of ap-



Analytical photo of W. E. fader, showing the location of various switches, and interior contacts, which are described in the accompanying text.



Schematic of Western Electric 49-A amplifier.

proximately 9.5 volts is thus produced as a grid bias for No. 2 tube. The negative bias will be affected if the "F" batteries are not fully charged.

The following action occurs during the operation of the 49-A amplifier: Assume a light flux entering the photo-electric cell equal to the light passing through unmodulated sound track. A steady current of definite value will, under this condition, flow from the 90-volt battery source through the ½-megohm coupling resistor, through the photo-electric cell, and return to the battery. This steady current flowing through the ½-megohm resistance causes a voltage drop which is applied to the coupling condenser and therefore to the grid of the first vacuum tube.

The potential on the grid of the tube will be increased or decreased, depending upon the direction of the current through the ½-megohm resistance. The grid potential will increase, because a time interval is required before any disturbance in the grid circuit can leak off through the 10-megohm resistor connected between the grid and condenser and to the negative battery supply. It is obvious that any fluctuation of current through the ½-megohm coupling resistor will cause a proportionate fluctuation in the grid potential of the first tube, the limiting factors being the intensity of the change and the time interval, as well as the characteristics of the several units comprising the circuit.

Any change in the grid potential of the No. 1 tube will, of course, cause a similar fluctuation in the plate current of the tube. The alternating current component of the plate current passes through the 1-microfarad blocking condenser, which is connected in series with the primary side of the interstage transformer. The A. C. component will, of course, traverse the primary windings and return to the filament of the No. 1 tube.

As previously pointed out, the D. C. component is supplied through the 37,500-ohm resistance. The potential of the A. C. component passing through the primary winding of the interstage transformer is increased in proportion to the ratio of transformation of this unit and is repeated into the grid circuit of the second vacuum tube.

The electrical pulsations are repeated through the No. 2 tube. In the case of No. 2 tube, both the A. C. and D. C. components pass through the primary winding of the output transformer, as no blocking transformer is required because an iron core in the output transformer, the operation of which is not affected by the magnetizing current of the D. C. component, the transformer being designed to operate under these circuit conditions.

The amplified A. C. component is repeated through the output transformer, and the signal voltage is impressed across the output terminals of this device. The final level of the amplified energy is approximately 5Db. when the initial signal voltage is generated by a normal photo-electric cell receiving light impulses which are modulated 100 per cent.

Testing Vacuum Tubes

ON many occasions it is the duty of the projectionist to test vacuum tubes for internal short circuits. A pair of headphones and a 4½-volt C battery are used for these tests. The 239-A vacuum tubes have two heavy tips and two lighter tips. The former are connected to the filament, and the latter are connected to the grid and plate.

Hold one testing tip to the grid and the other to the plate terminal of the tube. If the tube is in good condition, no click will be heard; but if clicks can be heard, there is a short circuit between the grid and the plate. Then, while still holding one testing tip on the grid, touch the other to either one of the filament terminals. A click again indicates a short circuit. Be sure not to use a testing voltage higher than the filament voltage of the tube being tested, or the filament may be accidentally burned out.

Some tubes develop sporadic short circuits which manifest themselves only now and then. To find such defects, one should gently tap the tube while testing, holding it in a horizontal position, and turning it around gradually. For such test it will be found handy to use clips on the ends of the phone cords, which are snapped to the tube tips, which enables one to manipulate the tube more easily. Vacuum tubes which have internal short circuits must be discarded immediately.

Loose Tube Bases

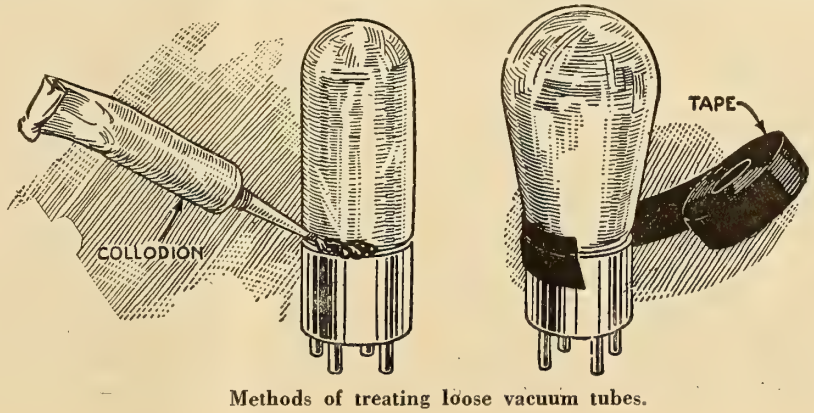
Many vacuum tubes have been discarded, I have found, because they become loose in their base, especially if they are inserted and removed from the sockets frequently. The cement holding the glass to the bakelite base sometimes dries out so that the glass cracks and loosens. There is then danger of twisting the wires inside of the base when inserting or removing the tube from a socket, and such twisted wires would result in a short circuit. Tubes otherwise in good condition may develop this condition, but it is not necessary to discard them, as a simple and effective repair may be readily made.

Wrap a layer of adhesive tape partly over the glass and partly over the top of the base, as shown in the accompanying illustration. This will prevent the tube from being turned around in the base, although care should nevertheless be taken when removing it and reinserting it in the socket.

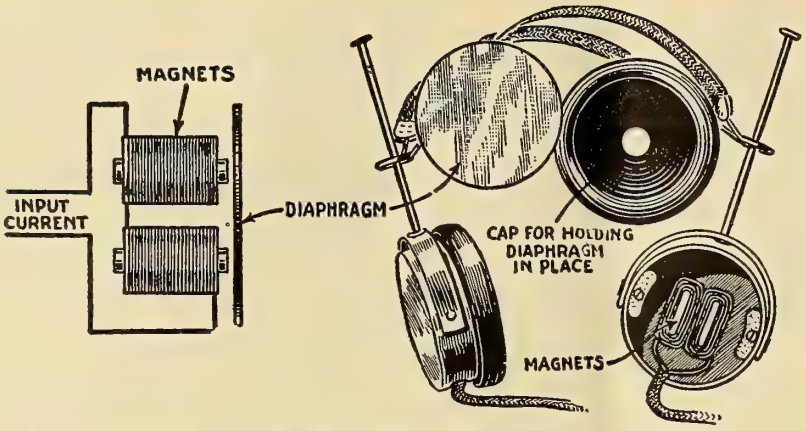
Another remedy for this trouble is to scrape away the surplus cement protruding above the base, and as much as possible between the base and the tube. Then apply some "New Skin" or collodion, letting it run down between the bulb and the base, and permitting a liberal film to dry on the outside over both.

Use of Soldering Irons

Every projection room where sound equipment is installed should have a good electric soldering iron on hand. In amplifier circuits it is absolutely essential that all connections be mechanically and electrically tight. If this is not the case, there may be considerable loss of energy due



Methods of treating loose vacuum tubes.



Left: Magnets and diaphragm of headphone. Right: Headphone with cap and diaphragm of one earphone removed.

to high resistance joints, or reproduction may be noisy due to loose connections.

A soldering iron for use on amplifier circuits must have a long, narrow nose to enable the user to reach into places which are inaccessible with a heavy iron of a kind used by tinners. Some sort of rest is necessary to lay the hot iron on while it is not in use. Recently a serious film fire occurred due to negligence in laying down a hot soldering iron on a rewind bench. It is essential that such irons be protected with a hood, so as to avoid any such possibility.

Sound Projection Hints

Recently I visited one theatre and found the sound volume to be very low, during the presentation of a disc sound accompaniment. After a brief check it was found that the fader contacts were very dirty. Cleaning the contacts restored the volume to normal.

During a visit to another theatre, the signal buzzer in the projection room (controlled from the observer's station in the audience), was picked up and could be heard in the sound reproduction. This trouble was eliminated by removing the phone and signal, and installing them elsewhere in the projection room.

The success of sound pictures is due to proper presentation without interruptions. It is remarkable how the industry has handled this new development and has achieved so much attainment. Managers know more about motion picture projection now than ever before. Not so long ago, it was a general habit for a manager to go to the house phone, during an interruption in the performance, and request the projectionist to give him a detailed report about the trouble; but now it is entirely different. The manager realizes that during trouble in the projection room the projectionist's time is occupied in locating the trouble instead of answering the telephone giving an explanation of the interruption, and in many instances the manager has greatly assisted by visiting the projection room, and finding out the true facts about the interruption.

With the success of sound pictures comes the elimination of many old practices. One of these items is the ringing bell of the theatre inter-phone. These bells must be muffled, so that they are not an annoyance to the audience. Theatre patrons must not be conscious as to the certain operations of the theatre. Another annoyance to the audience is the signal system. We realize the importance of the signal system in theatres where stage attractions are presented. It is imperative that all buzzer signals be muffled so that they are not perceptible to the audience.



Method of testing for noisy "B" battery

While equalizing the volume of both sound projectors, it will be found that by using the cut-out key on the fader this adjustment can be made much easier than by using the dial on the fader. Many times noisy reproduction can be traced to the first tube in the 41-A amplifier not making proper contact.

A rectifier tube may become paralyzed on high volumes. If the amplifier cuts off during effect records, it would be best to check carefully the rectifier tubes. Systems picking up A. C. hum and mechanical noises from machines, and decided noises picked up from marquee flashers, may be eliminated by disconnecting the ground to the projector base from the grounded side of the A. C. supply.

It is imperative that the coupling between the 555-W receiver and the horn be kept perfectly tight, otherwise a blasting noise will be perceptible. If the Movietone optical system lenses and exciter lamps are allowed to become dirty, the quality and quantity of sound will suffer.

Testing "B" Batteries

Two 45-volt dry B batteries are used in the photo electric cell and pick-up amplifier circuit each sound projector with W. E. systems. Although in a few cases dealers resort to the amperage test on B batteries, such a test means very little and does not show their true condition. The only accurate test on B batteries is a voltage test. Each cell must be tested separately. B batteries should never be tested for voltage after they have been standing idle for some time, for when standing idle they recuperate to some extent and during the first few minutes of their subsequent use they will produce a higher voltage than they will after being used for several minutes.

Noisy B Batteries

When 45-volt B batteries drop down to 37 volts, they become noisy. Even new dry B batteries may sometimes be noisy. Noise in B batteries is caused by fluctuations in voltage, resulting from poor or defective cell insulation which is not entirely moisture-proof; by the quality of the compound used in the cells, or by impurities in this compound; by faulty cell construction, and by loose internal construction.

Every new B battery should be tested before installing in the circuit, as shown in the accompanying illustration. Connect a set of headphones in series with a one-microfarad condenser across the positive and negative terminals and listen for noise. It is imperative that a one-microfarad condenser be in series with the headset. Be sure that the connections between battery terminals and headset are perfectly tight, as any slight movement in connections will cause a noise in the phones, and result in incorrect deduction from the test.

NATIONAL HIGH INTENSITY PROJECTOR COMBINATIONS

H & C AND SUNLIGHT ARC LAMPS

Arc Amperage		*Size*	*Kind*
50	Positive	9m/m x 20"	Nat'l H. I. White Flame Projector
	Negative	5/16 x 9"	Nat'l Orotip Cored Projector
75	Positive	11m/m x 20"	Nat'l H. I. White Flame Projector
	Negative	11/32 x 9"	Nat'l Orotip Cored Projector
100-120	Positive	13.6m/m x 20"	Nat'l H. I. White Flame Projector
	Negative	3/8 x 9"	Nat'l Orotip Cored Projector

New Advances in the Art

RCA SHOWS PORTABLE SOUND REPRODUCER

RCA PHOTOPHONE, INC., has demonstrated recently a new portable sound picture reproducing apparatus which is designed for use in the educational field. By means of this portable projection apparatus more than 250,000 schools, colleges and universities; 200,000 churches, clubs and lodges, and the large industrial organizations will be enabled to provide the foremost lecturers, statesmen, scientists and industrialists in sight and sound, bettering, from economic and practical aspects, the printing press, lecture platform and radio studio.

Technical Data

Technically, the RCA Photophone portable sound picture reproducing equipment consists of a projector designed to accommodate standard 35 mm. film. The projector is designed to operate from a power source of 110 volts, 60 cycle alternating current, and has a standard sound film speed of 90 feet a minute. A picture 6 by 8 feet can be projected at a distance of 50 feet; pictures of other dimensions are possible with different lenses. In all its connections, the new equipment is foolproof with non-interchangeable plugs preventing error in connections.

Ruggedness is an outstanding feature of the new device. It is capable of withstanding the severest conditions of travel and attendant vibration, maintaining its adjustment at all times.

A. C. Throughout

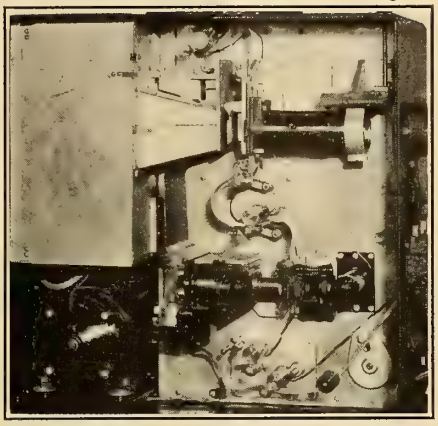
The amplifying system is alternating current-operated, adaptable to direct current. Equipment similar in every detail to RCA Photophone apparatus supplied for sound-on-film operation in the world's largest theatres is furnished, including a new improved volume control allowing adjustment from zero to maximum in steps of 2 TU. Rectifiers furnish the necessary direct currents. One of the exclusive elements of the equipment is accommodation in the amplifier for a second projector. This arrangement also provides a sound changeover switch, as in regular theatre installations, for changing from one projector to the other.

The loudspeaker is of an improved design capable of giving excellent speech intelligibility in any room or hall where a person speaking can be understood. Provision is made for mounting the speaker behind the picture screen.

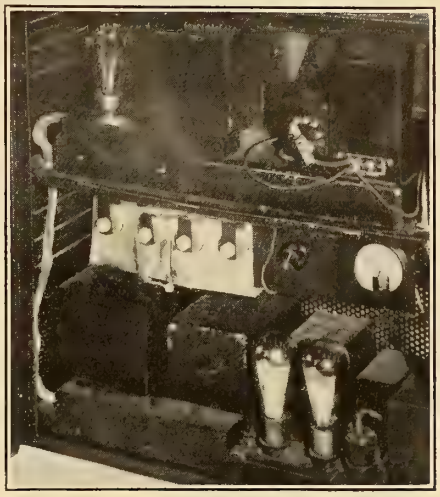
Similar to Theatre Model

In all its details, the new RCA Photophone portable duplicates the apparatus developed for sound projection in the theatre equipments of that company. The picture projection element of the system insures an excellent screen picture; the sound components provide sound, speech and music in perfect synchronism and with fine tonal quality.

Because of its standard design, the RCA portable projector can accommodate any talking film recorder in the present development of the art. A vast store of educational and institutional films is already available; others are now in production, and it is a positive eventuality that, as the greatest performers of the world's stages have flocked to the microphone, so will the geniuses of the arts and sciences record their knowledge and experience.



Interior of RCA projector



Amplifier for RCA portable

PRESTO RECORDING MACHINE

THE salient feature of the Presto Recording Machine is its vibrationless construction accomplished through the simple expedient of a belt drive separating the power unit from the recording head. By this simple and at the same time thoroughly mechanical construction the need of expensive filtering devices so necessary in geared constructions—and at best inefficient—is at once eliminated and there is provided a smooth, even, perfectly regular transmission to the recording head by which the slightest vestige of vibration is eliminated at the essential point.

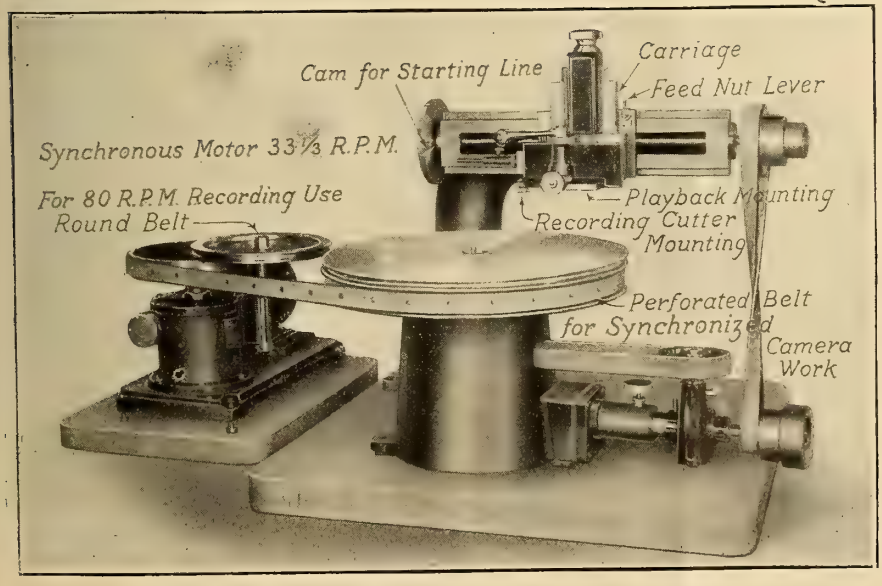
The machine is available for regular recording at 80 r. p. m. or 33⅓ r. p. m. for synchronized picture work. The change over is practically instantaneous. The belt drive for synchronized work is of such design and construction as to insure positively the established ratio and to maintain such ratio under any and all conditions.

In fact, the construction is such as to make the machine almost universal inasmuch as any desired feed can be made available by the simple substitution of a pulley on the recording end.

A vital constructional feature is the turntable tapered bearing which is self-aligning and automatically adjustable to wear without the need of end-thrust take-up. The bearing is a fit when made, remains a fit and there is no possibility of any play developing.

A convenient feature is a simple cam means for establishing a positive cutting starting point. The cutter point is dropped on the wax at the desired starting point and the simple operation of setting a stop against the cam face automatically produces the starting groove and the feed then proceeds at the predetermined rate. For straight recording a hand lever operation cuts the spiral groove at the end of the record.

A play-back is provided on the feed slide whereby immediate testing can be made without removing or disturbing the cutter head, means being provided for engaging or disengaging either the cutter or the play-back.



The new Presto recorder embodies many improvements

in the Laboratory

Conducted by SAMUEL WEIN

"Shield Grid" Amplifiers

UNTIL very recently but little work had been done with the "shield grid" tube (four element), for audio frequency amplification, although it is well-known that this type of tube does the work of two or three ordinary tubes in radio frequency amplification. The use of a shield grid tube gives rise to a greater voltage amplification per single tube than does any other commonly known type tube.

We are advised by some of our engineer friends that it is impossible to use the shield grid tube as an audio frequency amplifier. Despite this pessimistic outlook, however, the engineering staff of Radiovision Corp., New York City, has succeeded in amplifying the potentials generated as the result of light falling on the elements of a photo voltaic cell (liquid filled), used in their latest sound picture system.

By coupling the photo voltaic cell with a low impedance transformer (primary), the secondary of which is connected directly to the control grid of the tube, and thereafter using the conventional resistance-coupled amplifier, using shield grid tubes, they have succeeded in building a very efficient unit which gives rare tonal qualities. We are advised also that the RCA Photophone, Inc., has recently built a more efficient sound picture amplifier which employs shield grid tubes.

The advantages of shield grid tubes are: (1) the reduction of noises due to inter-stage coupling, (2) facilitate the use of A. C. operation throughout, avoiding the use of cumbersome batteries and their attendant care, and (3) amplifiers built with shield grid tubes require but very little space, as compared with other type amplifiers. We prophesy at this time that the audio frequency amplifiers of the future will be equipped with shield grid tubes, and their introduction into projection rooms for sound pictures will be a matter of course.

Colored Positive Stock

PRIOR to the advent of sound pictures, it was a common thing for certain portions of prints to be dyed (colored), in order to obtain various effects through shading. These effects were intended to enhance the pictorial value of the subject being shown on the screen. Now that sound pictures have become so popular, the lack of colored films has been the subject of considerable discussion among technical men. Not that it is impossible to produce colored films with sound accompaniment, but only two systems lend themselves easily to color sequences. These are: (1) sound accompaniment on discs, and (2) the variable area (saw tooth), method recording such as is used by RCA Photophone.

With the variable area method of recording there is no difficulty in reproducing sound from film for the reason that the light from the exciting lamp passing through the film bears the same ratio between the portion that is almost all transparent and that portion which is almost entirely covered by silver emulsion.

In the case of the variable density method, we find that the light passing through the brighter portion (transparent), of the sound track is much more affected by the dyestuff in the film than are the darker portions of the sound track. Therefore, the entire ratio of light falling on the photo electric cell is considerably decreased as a result of the use of dyes, which act as a light filter. This filtering action distorts the wave form of the sound as reproduced by means of the p.e. cell.

Two methods of solving this problem come to mind: (1) the use of a dye which will permit the proper amount of actinic light falling on the p.e. cell, giving the maximum output in the cell as a result of light passing through the "light filter" (blue has been used in experimental work), and (2) by means of a greater "photographic contrast." thus securing a greater change in the p.e. cell. Both methods still are the subject of considerable experimental work, and producers are bending every effort to perfect a process which will insure consistent productions of film which will not distort the wave form.

Recently the Eastman Kodak Company announced a series of tinted stock which was the result of extensive research along this line. This Eastman tinted stock represents an advance in the right direction, and it is fairly certain that Eastman workers will add materially to the art in the very near future.

"Electrified" Amplifiers

THE modern trend for engineers in talking motion pictures is the complete electrification of the amplifying units. By "electrification" reference is had to the entire elimination of batteries. The electrification of radio sets and amplifiers is a common thing to-day, but the electrification of amplifiers for talking motion picture systems is still the subject of experimental work by the engineering staffs of the various firms engaged in this field of endeavor.

The Exciting Lamp

We have recently witnessed two methods of battery elimination for this purpose. The methods were (1) the use of rectifiers and (2) the use of coarse filaments in the exciting lamp.

A prominent manufacturer has recently placed at our disposal a complete rectifier to handle any current and voltages available for exciting lamp by any of the available talking motion picture systems. This rectifier has been in constant use for over a period of several months, without any tendency to difficulties on the part of the rectifier, nor any requisite attendance on the part of the projectionist to this device.

The second method is the use of a special exciting lamp made for this purpose. From all outward appearances the exciting lamp is that of the conventional form, save for details in its filament. This special exciting lamp is fed from the "raw A. C." without any intermediate rectification. It was found by experiment that a heavy or coarse filament in the use of an exciting lamp will not correspond in illumination (not visibly), to the 60-cycle current, and therefore will have no effect on the photo electric cell. It is only the fine filaments that can readily be seen to vary with the 60-cycle variations in the line, and which therefore affect the photo electric cell.

Rectifiers

The company to which we have already referred in this text, has designed a special rectifier which we have had under observation for several months in a New York City projection room. This rectifier was designed to give enough current to supply the current for the filaments of three 239-A



Arrows trace path of film which passes aperture both laterally and vertically. New process not yet perfected for professional use

tubes on the 41- and 42-A amplifier board, as well as the potential for the exciting lamp and including the potential for the field windings on the 555-W receiver.

This amplifier gave no perceptible "ripple" in the loud speaker unit, even though the projectionist had his ear close up to the speaker unit. This has been in use for several months and the weekly reports are that it gives satisfactory results with no attention on the part of the projectionist to this rectifier.

Electrified Amplifiers

Here the amplifier panel consists mainly of a plurality of screen-grid tubes, all operating on A. C. potentials. These tubes are obtainable in the open market. The circuit used is one commonly known to the engineers; it is only a matter of adapting the tubes for the particular purpose.

The Royal Amplitone Corp. has recently demonstrated a commercial amplifier using this method of electrification of amplifiers, with the circuit having been designed by Mr. R. Miehling.

Special Methods

From a technical viewpoint, it is well to remember that the photo electric cell itself is a rectifier, and in some special circuits it is possible to use the conventional exciting lamp fed from the raw A. C. lines, with, of course, a proper resistance in its circuit to adjust the proper current to it. The photo electric cell operates as a rectifier, and this is connected with an electrified set, with the inclusion of a proper amplifier to further rectify the A. C. ripple set up in the photo electric cell circuit, from the exciting lamp.

Riggs Circuit Eliminates Negative Grid Bias

A NEW amplifying circuit of radically different design than any now in common use in the radio and sound picture field has been demonstrated in New York by Dr. Alger S. Riggs, who has already made many important contributions to the electro-technical arts. This new system eliminates negative grid bias, according to Dr. Riggs, and several authorities in the art who were present at the New York demonstration substantiated this claim.

The apparatus, according to a prominent patent attorney, does not include the use of negative grid bias, push-pull system, grid leak and condenser, neutralization and balancing and regeneration. The recent demonstration of this new system showed the use of the Riggs circuit with a radio receiving set, but there is no apparent good reason why the same principles may not be applied to the sound reproducing apparatus.

Reports from the demonstration have it that each stage was tested with a voltmeter and all revealed positive bias. The engineers, it was said, admitted that Dr. Riggs showed the circuit could do everything he claimed for it. The following general explanation was made by Dr. Riggs:

Eliminates Negative Bias

"In general, the system as at present conceived and evolved consists essentially of a fundamental and revolutionary method of securing amplification by the use of electron discharge devices. Among other things, the system displaces the necessity of utilizing negative C bias throughout. In fact, in the major portion of the application of electron discharge devices the electron stream is not controlled by the grid at all.

Far Sound Pictures

"The radio set demonstrated does not use (a) negative C bias, (b) tuned radio frequency and (c) grid leak and condenser. As I demonstrated it, the set was in its semi-laboratory form, no production or design engineering having been applied toward its completion."

It is claimed that the Riggs system covers more than a radio broadcast receiver. Its sponsors declared that, in view of the revolutionary principles involved, broad patents will be granted covering the use of the system in radio receivers, radio broadcast transmitters, commercial radiotelephony, commercial radiotelegraphy, land line telephone repeaters, specific high accuracy frequency measurements, amplification of extremely high radio frequencies and motion picture sound recording and reproducing apparatus.

New Exciting Lamp—Battery Eliminator

SINCE the publication of results of experimental work looking to the elimination of battery potential for the exciting lamp, we have discussed with several workers divers means of accomplishing this end. Of the various experiments tried and methods advocated, that which we are about to describe is, in our opinion, the simplest of all and the least expensive.

The principle involved in this battery eliminator is the insensitiveness of a heavy filament in a lamp to the ripple, or 60-cycle alternations, of an A. C. source. In other words, it was found that if a thin filament is used in the exciting lamp, it would correspond to the 60-cycle A. C. source; but on the other hand, if a husky filament is used, it will be found to be insensitive to the 60-cycle variation, i. e., optically speaking, and so the photo electric cell can be used in the circuit with which a raw A. C. is fed to the exciting lamp.

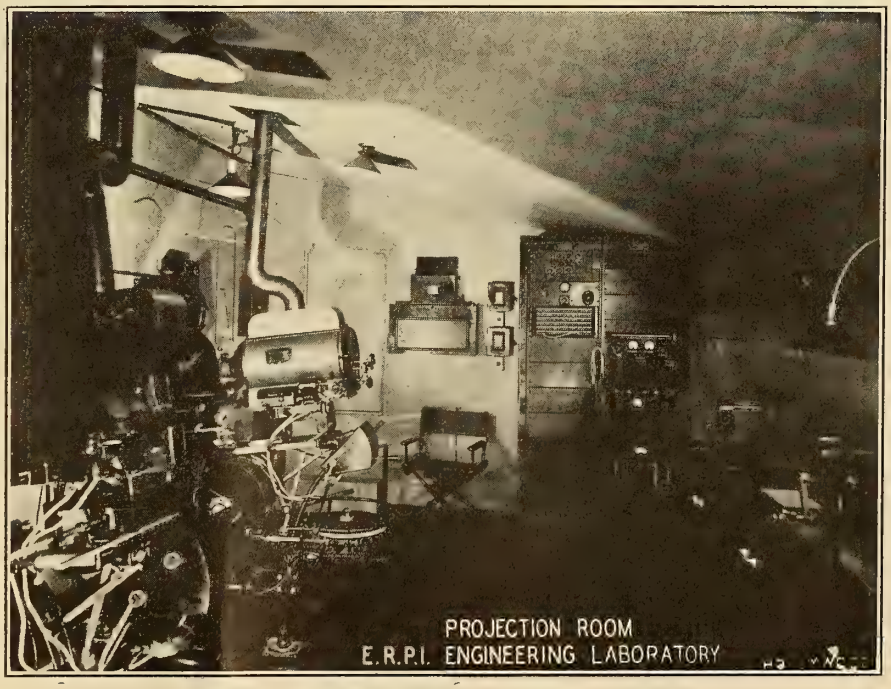
Use Huskier Filament

In order to affect the photo electric cell, the filament of the exciting lamp must be sensitive enough to respond to the 60-cycle A. C., thus giving rise to a ripple. Thin filaments do respond in this fashion; but coarse filaments do not. And so the replacement of the thin filament by the coarse filament is now the subject of extensive and intensive experimental work.

We have recently witnessed a demonstration where raw A. C. from the source of supply was reduced to 10 volts and about 7½ amperes, in which the horn produced only a slight ripple. In fact, the ripple was audible only if one held his ear very close to the speaker unit.

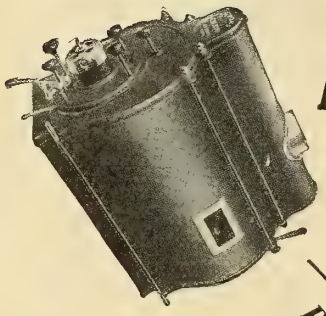
Eyestrain

There have been endless complaints at different periods in our history of eyestrain, headache and a host of associated evils due to various optical defects which we have successfully eliminated. Let us grant that all these claims are scientifically ill-founded. The fact remains that a patron who sits through a picture well below the standard of optical brilliance to which he has been accustomed will be conscious of a definite lack in the entertainment value of the show. He may not analyze it, but his feeling of satisfaction will be impaired nevertheless. If we do not wish to hear a recurrence of these complaints from bigoted and prejudiced quarters, we must remedy the defects which have unavoidably been introduced.



Layout of projection room in ERPI laboratory.





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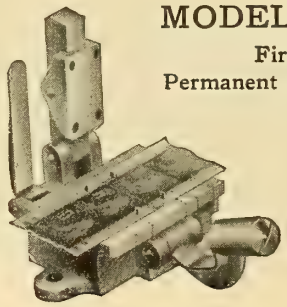
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For sale by all Supply Dealers

E.R.P.I. Acoustic Bureau Serves Theatres

ACOUSTIC analyses of more than 500 theatres have been made during the last six months by the special acoustic department of Electrical Research Products under the direction of S. K. Wolf, acoustical expert. The work of organizing this department was started a long time ago but any announcement of its formation and operation has been carefully withheld until important fundamental research and development work had been

Disc Pick-up Process

(*Continued from page 23*)

distance covered each side of center by the moving contact arm, the greater will be the voltage generated. But the amount of motion is limited by the spacing between grooves on the record and the shortening of the gap is limited by the fact that the magnetic field will pull the armature over to it unless the rubber is made very tight.

This action of the magnetic field on the armature is in the nature of a negative spring but, contradictory as it may sound, is not equivalent to mass. If the spring action of the rubber dampers is not sufficiently strong to prevent it, sticking of the armature will occur on either side of the gap, under which condition the unit is inoperable. An ideal condition would be had if the action of the rubber exactly counterbalanced that of the field at all points. This would result in no resonant frequencies and would show preference to low frequencies. But such a condition could not be obtained except in a laboratory and even then the adjustment would be off in a short time, as soon as the rubber "set" a little.

Unlike loud speakers, the dynamic principle is not advantageous in pick-ups. The dynamic speaker is capable of more volume because the amount of permissible motion of the cone is several times as great as that in the magnetic type. But the extreme amplitude of motion of the moving parts of a pick-up is fixed by the spacing between grooves on a record, and the magnetic type is easily adapted to this amount of motion.

After all, it is immaterial, from an electrical viewpoint, whether the field is varied or whether the coils are varied. Alternating flux through the coil is the result in either case, and that is what produces the voltage.

On the other hand the dynamic principle, applied to the pick-up, is not as good as the magnetic type since, for a given frequency, the value of voltage is proportional to the amount of motion. This means that those frequencies below 250 cycles will be slighted in reproduction, the same as they are on the record. But low frequencies are cut with a relatively high amplitude and consequently, in the magnetic bridge type, these frequencies are accentuated because, unlike the dynamic, the voltage produced by the bridge principle goes up faster than the amplitude of motion.

completed and until some definite accomplishments could be pointed to.

The department at present consists of a staff of 17 men under Mr. Wolf's direction. Behind its operations are the research facilities of the Bell Telephone Laboratories and the more than 750 installation and service engineers and technical inspectors of Electrical Research Products who aid in making surveys and collecting statistical material. In every case where an acoustic analysis has been made the department has offered detailed recommendations for treatment to overcome any difficulties caused by theatre conditions.

The department is enabled to make suggestions for acoustic improvements, unhampered by obligations to the use of any particular material. Complete files of data on all acoustic materials are maintained, and the particular material or combination of materials may be selected that is best adapted to the particular conditions in each theatre. These conditions include a consideration of the cost and appearance in addition to the acoustic requirements.

Revise Reverberation Figures

The work of the acoustic department is divided into two branches: analysis and development. The first-named branch is devoted to field work in the practical analysis of theatres and in service to the industry. The latter is devoted to research work and the development of acoustic knowledge.

The work of the development branch has already resulted in important findings. It has been determined that the time of reverberation for best acoustic conditions in a sound theatre does not correspond to the figures which have long been accepted by acoustic authorities; and a new figure has been determined. This finding has been checked by a thorough study of more than 50 sound theatres which are known to possess excellent acoustic qualities, in addition to 500 theatres needing acoustic correction. To carry on its research and experimental work the development branch has fitted a theatre in Brooklyn as a laboratory where tests and examinations in good and bad acoustics are now carried on.

"The most important factor in good sound reproduction is the time of reverberation," declared Mr. Wolf in describing the work of his department. "This, defined in lay terms, is the length of time the sound remains audible. It is difficult to give out general rules for theatre construction and equipment because each theatre presents an individual problem and it would be misleading to say that any single rule or set of rules could be applied without exceptions.

Square Auditorium Best

"Generally speaking, the theatre with an almost square auditorium reproduces sound with the best results. The theatre in which it is most difficult to get good sound reproduction is the long, narrow theatre with a low ceiling. The presence of rugs and carpets improves sound reproduction because they not only absorb sound but lessen the noise caused by movements in the aisles. Seats can make a great difference in good or bad reproduction. Without going into a maze of details we can simply lay down the general rule that a seat should be able to absorb nearly as much sound as an individual person. Heavily upholstered seats approach this condition and permit good reproduction with either large or small audiences, a condition not obtained in theatres with wooden seats.

"More and more, we find, exhibitors are realizing the importance of good sound reproduction and are giving attention to the factors that contribute to it. In this respect we are able to offer them unbiased service. We can make a study of each theatre individually and make recommendations accordingly. The requests for cooperation that we are receiving from theatres is the best evidence of how much appreciation there is for this pioneering work.

STANDARD EQUIPMENT FOR PUBLIX, FOX, RKO

AND OTHER GREAT CIRCUITS

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WALKER SOUNDSCREEN
PATENT PENDING

IT Delivers

50% More Light

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No Fadeaway

BRILLIANT PROJECTION WITH LOW INTENSITY

The logical screen for your theatre

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85—35th Street Brooklyn, N. Y.

Notice

IN our advertisement in the November issue of THE MOTION PICTURE PROJECTIONIST our address was incorrectly stated as 451—39th St., Brooklyn, N. Y.

We wish to direct attention to our correct address listed below.

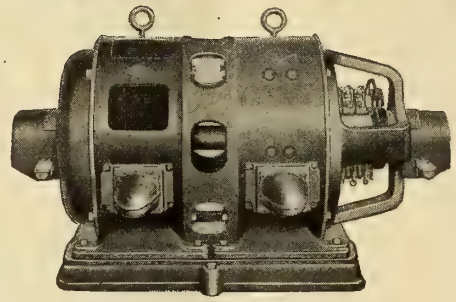
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M-G Sets make possible a New Standard OF QUALITY PROJECTION



Imperial Two Bearing M-G Set

because they contain several Imperial features that contribute to better projection.

This new standard is the result of our effort to develop a product that would give Projectionists the best results possible.

The following are four outstanding features.

1. Quiet operation without vibration.
2. Heavy overload capacity for short periods.
3. Constant voltage at Arc.
4. Reliability.

In checking over, you will find that they are ALL required in order to render the BEST RESULTS. They are built into Imperial M-G Sets with the result that wherever Imperial M-G Sets are used they receive the most enthusiastic praise and the highest endorsements from Projectionists.

They are priced right and are suitable for large and small theatres. Furnished with ball or sleeve bearings. Motors up to 30 HP. are self-start type, requiring no expensive compensators saving both first cost and upkeep. Imperial also has a line of Battery Charging and Emergency Lighting Equipment.

OUR BUSINESS CREED

1 Quality
2 Service
3 Right Prices
4 Courteous Treatment

Imperial makes a complete line of Quiet Running Motors for Ventilating Systems, Pumps, Elevators, etc.

Distributors write for Territory Rights

THE IMPERIAL ELECTRIC CO.

AKRON *Established 1889* **OHIO**

Offices in Principal Cities

PHOTO-CELLS, neon lamps, special high vacuum or gas filled tubes, and noise-free liquid grid leaks, manufactured to specifications.

ARGCO LABORATORIES, Inc.

150 West 22nd Street New York City

P. A. C. Luncheon to Pres. Canavan

(*Continued from page* 20)

Local Union 182; the practice of inviting newspaper picture critics to inspect a typical modern projection room; the matter of securing daily newspaper publicity for projection and projectionists; and the compiling and disseminating of general projection information by the Projection Advisory Council.

The time for the open forum was unavoidably curtailed, but it would seem that this circumstance did not affect the success of the affair for the reason that not a little interchange of information was accomplished at the various individual tables on the floor during the progress of the luncheon.

P. A. McGuire of the International Projector Corp. was the general chairman on arrangements for the luncheon, and he was materially assisted in his fine work by Charles F. Eichhorn, Laurence Jones, Lester Isaac, and George Edwards, all of whom are members of Local Union 306.

In addition to President Canavan's address, there follows a complete list of guests who were present at the luncheon.

President Canavan's Address

In attempting a discussion of the importance of motion picture projection, one who has been intimately associated with this particular branch of the motion picture industry for many years may be charged with over-enthusiasm. It is not, however, my purpose to over-emphasize the relative importance of projection and the projectionist to this great industry of which we are a part. Rather do I seek to dispel the popular misconception of a great number of people who through lack of information and understanding of the subject fail to realize the true importance and significance of the mechanical presentation of the motion picture.

To those of us who have a personal interest in this particular subject, there is great satisfaction when we visualize the tremendous strides that have recently been made in the development of projection room practice and equipment. These recent developments have been of signal importance to the millions of patrons of the justly popular motion picture entertainment, and have given a new impetus to one of America's leading industries. Some one has well said, "This is the age of electrical entertainment." The vast patronage with which the motion picture theatres have been favored is the greatest assurance that these technical and mechanical developments have found instant public favor, and that developments of similar character will be received with like satisfaction by the general theatre-going public. The worlds greatest research laboratories, presided over by the outstanding scientific and mechanical minds of our times are at the present moment bending every effort toward the development and perfection of the technical side of the motion picture art. Already we have assurances of the development of third-dimension projection to a commercially practicable point. The mechanical development of projection equip-

ment and projection practices is unquestionably destined to play the leading role in the future development of the motion picture industry.

With the coming of these vast changes in projection room practice and equipment, the members of the projectionist Local Unions throughout the United States and Canada are fully alive to the great responsibilities that will devolve upon them and are preparing themselves by intensive training and study to meet the changed and changing conditions in projection problems, come what may. The theatre-going public, to whom the motion picture theatre has come to be an indispensable necessity, and those who have hundreds of millions of dollars invested in this industry, need have no concern regarding the ability of the projectionist to cope with the new projection problems.

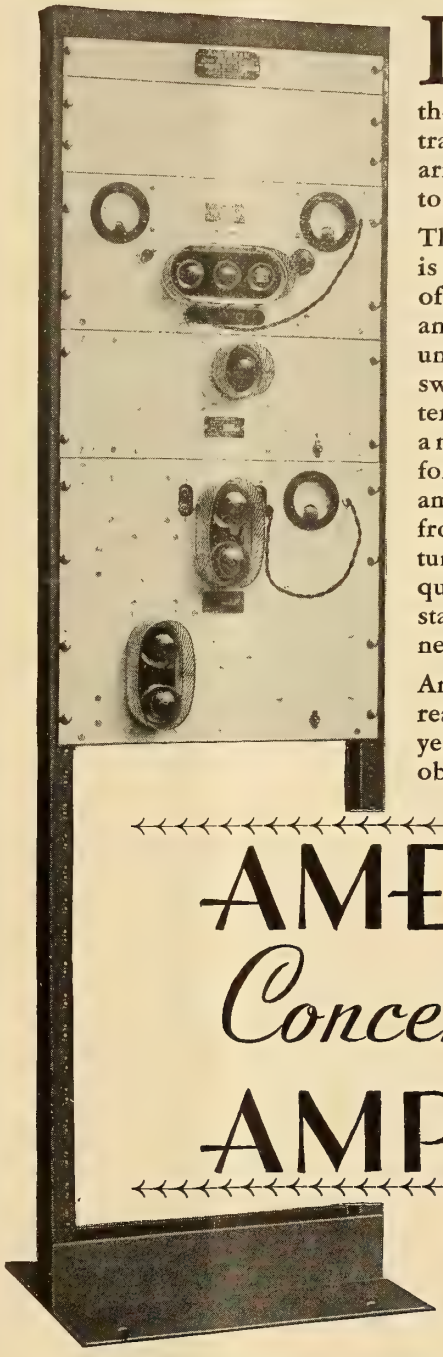
To the everlasting credit of the projectionist, it can be said that he never shirks his responsibilities. New projection room equipment, no matter how complicated it may be, is always a welcome addition to the projection room, even though past experience clearly indicates to him that laboratory developed equipment brings with it added worry and work. The projectionist is more of an idealist than a working man. He looks upon motion picture projection as a "specialized art," and is ever striving to improve the quality of screen entertainment even though it entails a personal sacrifice. The consciousness that the success or failure of the entire screen performance is dependent upon his skill and its application in the handling of the delicate projection equipment, has a natural tendency to arouse the projectionist to a sense of the great responsibility of his profession. He approaches his task, not from the standpoint of a worker who is to receive a monetary consideration in the form of wages for a given number of hours of service, but rather from the standpoint of an artist, mechanically etching upon the silver screen a series of photographic images that are unfolding to his movie audience a visual impression of a story told with the aid of his mechanical pen. And at the same time he deftly manipulates the projection sound equipment in a manner so as to give proper modulation to the spoken voice in syncronism with the photographic images, so that the illusion of life and voice in his story book characters may be complete.

The introduction of sound presented a series of problems that were entirely new to the projection field. To begin with, the sound equipment had only been subjected to laboratory tests prior to its installation in the theatre. These tests had been conducted under uniform and ideal conditions, by technicians who had developed apace with the sound equipment.

But theatres could not be re-constructed so as to make them ideal for the new sound installations. The physical conditions obtaining in many of the theatres were such that it was next to impossible to achieve the desired results. Each installation presented its own particular problems that could only be solved after subjection to practical tests. That the original installa-

(*Continued on next page*)

THE NEW POWER AMPLIFIER



IN projecting sound to reach large assemblages of people in ball rooms, in the open air, or in rooms larger than those in the average home, the volume transmitted must be greater than is ordinarily attainable, but without the loss of tone, quality, or fidelity of reproduction.

The AmerTran Concert Hall Amplifier is distinguished for its exceptional purity of tone and exact reproduction of music and the speaking voice without distortion under greatly augmented volume. Of switchboard type construction with interchangeable panel sections, it requires a minimum of floor space. Being designed for either direct or remote operation the amplifier may be located at a distance from the speaker and from the radio tuner or other input source of audio frequency. Entirely AC operated; three stages of audio amplification; uses the new UX250 tubes.

American Transformer engineers are ready to give you the benefit of many years' experience. Consult us freely—no obligation involved.

AMERTRAN *Concert Hall* AMPLIFIER

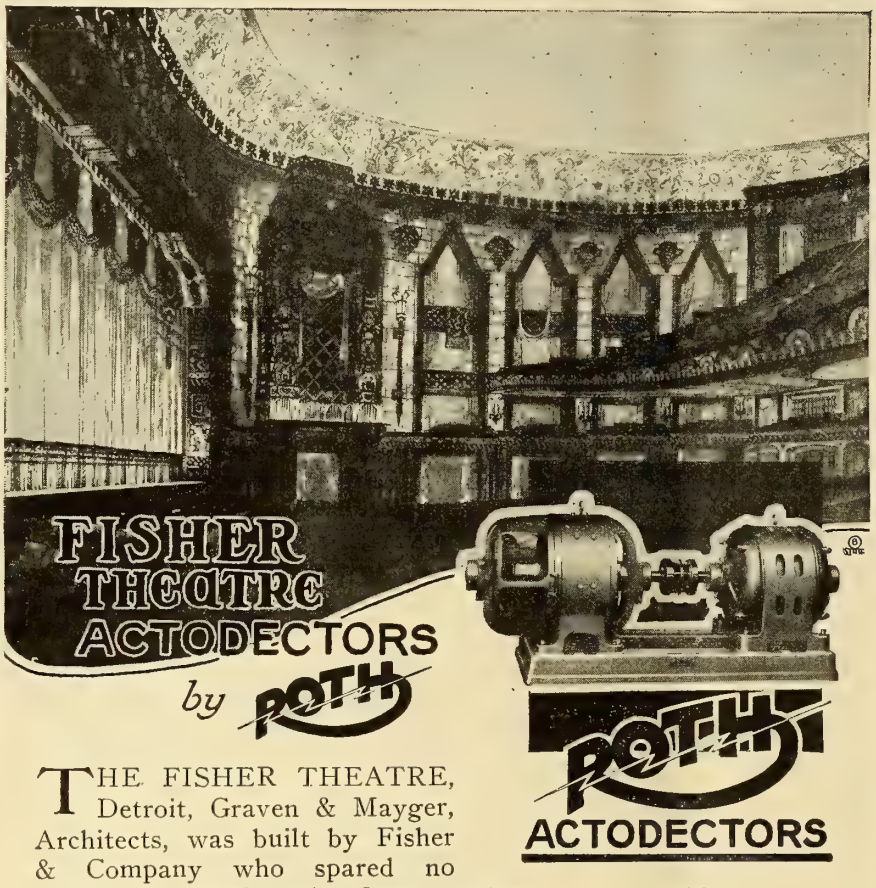
OUTSTANDING FEATURES

1. Purity of tone and speech with great volume.
2. Requires minimum floor space.
3. Direct or Remote operation.
4. Three stages of audio amplification.
5. Uses the new UX 250 tubes.
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THE FISHER THEATRE, Detroit, Graven & Mayger, Architects, was built by Fisher & Company who spared no expense in getting the finest equipment procurable.

It is significant that ROTH Actodectors—two of them to be exact—were chosen to furnish direct current for the projector arcs.

Just as this theatre exemplifies all that is fine in design, equipment and construction, so does "ACTODECTOR" on a motor generator mean clear, intense, flickerless projection even during changeovers.

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Optical Crown Glass Plates

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tions of projection equipment, for the reproduction and amplification of sound were not perfect, is not difficult to understand.

After the installation was made, the responsibility of operating and maintaining the sound equipment became the duty of the projectionist who had little knowledge of the complicated device, aside from a few hours of operating instruction. This unfamiliarity was not due to his indifference. There had been no opportunity to secure the technical information necessary or to prepare himself for this new responsibility. From the outset it was apparent there would be trouble. Many changes had to be made before the sound equipment measured up to the exacting exhibition requirements of the modern motion picture theatre. The projectionists who pioneered the introduction of sound have every right to feel a great satisfaction in the contribution they made to the development of this art.

The men who have solved these problems in a practical and highly satisfactory manner are to be congratulated. They are deserving of the highest commendation from the entire motion picture industry for this splendid service.

The audience cannot be expected to appreciate the painstaking efforts incorporated into the work of the projectionist in attempting to present for their enjoyment a faultless screen performance. How are they to know of the projection problems to be overcome in producing the screen results which they expect and demand? They have no means of knowing that at each performance more than ten thousand feet of delicate film of a highly inflammable nature is being driven through the intricate steel projection mechanisms at a high rate of speed and that this operation is repeated as often as eight times in a single day. Would it matter if they were to know of the intense heat to which the film is subjected in passing before the concentrated light rays and of the consequences of even a momentary stoppage of the film under such conditions. How are they to arrive at an understanding of the constant care and attention necessary on the part of the projectionist in caring for the equipment so there may be no interruption in the performance? It seems to me that a proper appreciation of the work of the projectionist by the theatre patron, and by others who should be better informed, will not be forthcoming until we have succeeded in dispelling the popular misconception that the duties of the projection room staff are to operate and care for electrical and mechanical devices which are automatic in operation and require but scant attention.

No attempt will be made by me to stress the mechanical ability of the capable projectionist. Neither shall I dwell upon the requisite understanding of electrical phenomena which is indispensable to the solution of projection room problems. Of his familiarity with the principles of optics, I shall only say that without this knowledge, the splendid image definition which is characteristic of the finished screen performance would be impossible of attainment, and the beautiful photographic results of the skilled cameramen would be wasted.

It is true, of course, that an able projectionist must be a good mechanic, but

it does not naturally follow that a good mechanic would be an able projectionist. My impression of the matter is that real showmanship is one of the most essential qualities for the real projectionist. He must be show-minded in all that the term implies, with a background of theatrical experience which will imbue him with that theatrical spirit,—"The show must go on," no matter what may happen. No amount of academic training alone could possibly produce an outstanding projectionist. The essentials for good projection are not to be learned out of books alone. True, the theoretic approach will be of value to the novice and will be highly beneficial to the experienced projectionist; no man ever lived who knew as much as he ought to know. When a man reaches the point where he imagines he has all the knowledge he needs, it is a certain indication of his need of it.

Physical conditions in the construction of a theatre necessitate locating the projection room at some point remote from easy access. It seldom has visitors. Indeed, the larger theatres are strict in enforcement of the rule forbidding visitors in the projection room. In many cities there are ordinances which forbid any but a licensed projectionist from entering. As a result the projection room is a sort of mystery place little known to the average person. The projectionists live a hermit's existence while on duty and find their time well occupied, especially so since the advent of the audible film which requires constant care and attention.

When sound is recorded on disc, the projectionist must be constantly apprehensive of mishaps for the reason that once the film and recorded disc are out of syncronization, the performance is utterly ruined, as there is no practical method yet devised to re-syncronize the disc and film. No mishap occurring in the projection room causes the consternation that is occasioned when disc and film are not in syncronism. Sometimes the projectionists are at fault, but more often the fault lies in some defect in the film, the disc, or the mechanical attachment. It is to be expected that the projectionist will be blamed for any mishap which may occur, especially by the audience. In the many years that I have been connected with the theatre, I have never witnessed any mishap which so thoroughly irritates the audience as does an interruption in the showing of a sound subject. Under such a condition the audience becomes restless and gives full expression to their feelings in no uncertain manner.

Not so long ago the entire projection room equipment for the finest theatre could have been purchased at a cost of less than $5,000.00; while today suitable equipment may reach a cost of $50,000.00. This latter sum would, a few years ago, have been sufficient to have paid the entire cost of building and equipping throughout an entire theatre of goodly proportions. It is a pleasure to note that the better class of theatres have at last come to a realization of the importance of the

(*Continued on next page*)

F/2.5 BI-FOCAL Super-Lite Projection Lens



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AS the name implies this new construction offers the projectionist everything he has been looking for; two focal lengths in one construction.

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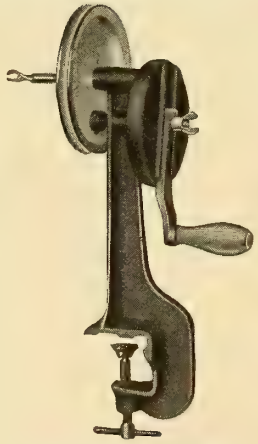
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projection room and are furnishing adequate and modern projectors and equipment, which enables the projectionist to produce proper screen results. It is to be regretted that many theatres are still using inadequate and antiquated equipment. Good projection requires good projectors. Poor screen results will do more to injure a theatre's reputation and patronage than any other single factor. Bad projection and good business are never companions. Show me a theatre where proper projection standards are not maintained, and I shall show you a theatre where business is in the same category as its projection.

In closing, may I not express the hope that, in the not far distant future, there may be a better understanding and appreciation on the part of motion picture audiences of projection and its importance in presenting and emphasizing the visual and audible artistry of the production staff that has been so painstakingly incorporated into the production by the director, the cameraman, the actor and the technician. A proper understanding of "projection, a specialized art" will add immeasurably to one's appreciation and enjoyment of the performance. I want to caution all of you who are projectionists against ever being satisfied with projection mediocrity. There is always room for improvement, no matter what has been accomplished. Perfection in projection has not been achieved, irrespective of the splendid progress that has been made. Let all of us who are interested in the advancement of the science of motion picture projection rededicate our purposes to the continuance of the drive for better projection, a drive not rooted in selfishness; an effort not in the interest of personal gain, but a contribution to the motion picture industry through co-operation and good will. Let us spare no effort to enhance the value of the motion picture as an art by earnestly and constantly striving for greater appreciation of motion picture entertainment through the application of the scientific principles and practices which produce the highest standards of motion picture projection, thus giving increased pleasure and satisfaction to the millions of motion picture patrons, whose goodwill and patronage are indispensable to the future development and permanence of the entire motion picture industry.

List of Guests

Harry Abbott, L. 307; P. M. Abbott, M. P. News; Joseph Abrams, Le Roy Andrews, Boston; George S. Applegate, ERPI; John Armitage, L. 485; L. R. Baird, L. 384; Frank Baker, Wash., D. C.; Donald Ball, L. 329; Thad Barrows, Pres. L. 182; J. D. Basson, L. 306; M. C. Batsel, RCA Photophone; Milton Berkowitz, L. 306; J. Bernheimer, Wash., D. C.; A. Bernstein, Publix; Edward Black, L. 203; Lester Bowen, Int. Proj. Corp.; James Burke, L. 182; S. R. Burns, Int. Proj. Corp.

Also James R. Cameron, Pres. William Canavan of the I. A. T. S. E., Fred Castle, L. 306; Joe Ciffre, Nat. Thea. Supp. Co.; Joseph Clayton, L. 306; H. C. Conrad, Leo Cowley, George Cushing, L. 485; Frank R. Day, L. 306; Oliver De Freitas, E. De Hart, L. 384; George De Kruif, Nat. Thea. Supp. Co.; Fred J. Dempsey, 1st

V-P of I. A. T. S. E.; Albert De Titta, L. 384; Harry Dignam, Asst. Pres. of I. A. T. S. E.; H. Dulborger, L. 384; John Eberson, architect; E. Ederhart, L. 384; George C. Edwards, L. 306; Charles F. Eichhorn, L. 306; John D. Elms, Fox Grandeur; B. A. Erickson, Elisha Evans, L. 384.

Also James J. Finn, Motion Picture Projectionist; Charles Fossa, Boston; J. E. Francis, RCA photophone; A. B. Freeman, William Friedman, Ray Gallo, N. D. Golden, Asst. Chief M. P. Div., U. S. Dept. of Commerce; Sam Glauber, Publix; Arthur Gray, L. 182; Benjamin Green, L. 307; B. F. Greene, Dept. of W. G. & E., N. Y. City; Herbert Griffin, Int. Proj. Corp.; John Griffiths, C. F. Grishaber, John Gulfo, L. 384; Peter Haller, J. A. Harding, H. V. Heck, John M. Hobley, L. 4; E. Hoffman, Hoffman & Soons Co.; Fred Holby, L. 4; Max Hollander, L. 306; J. J. Hopkins, Publix; T. L. Hopkins, Wash., D. C.; Willard Howe, M. P. Review; W. C. Hubbard, Treas. S. M. P. E.; Charles Humphrey, Lester Isaac, Pres. Projec. Adv. Council; Horace Johns, and Larry Jones, Sec. P. A. C.

Also Sam Kaplan, Pres. L. 306; Lawrence Katz, L. 488; Otto Kafka, L. 306; T. C. Kennedy, Sam Kessler, L. 329; E .T. Keyser, M. P. Today; A. Kindleman, R. C. Kneur, Fred Krause, L. 4; Louis Krause, I. A. Pa. representative; W. C. Kunzmann, Nat. Carbon Co.; W. D. Lang, Mgr. Claim Dept. I. A. T. S. E.; Charles Levin, Albert Linde, L. 4; Boone Mancall, Motion Picture Projectionists; Frank Mandrake, L. 384; P. A. McGuire, Int. Projec. Corp.; Dr. T. McGuire, W. C. Michel, Int. Projec. Corp.; John Miller, L. 384; J. A. Milligan, Associated Publications; George Miles, L. 329; B. Morel, L. 306; Morris Moriarity, L. 273; Dr. Morton, N. Y. C. Health Dept.; H. B. Mourier.

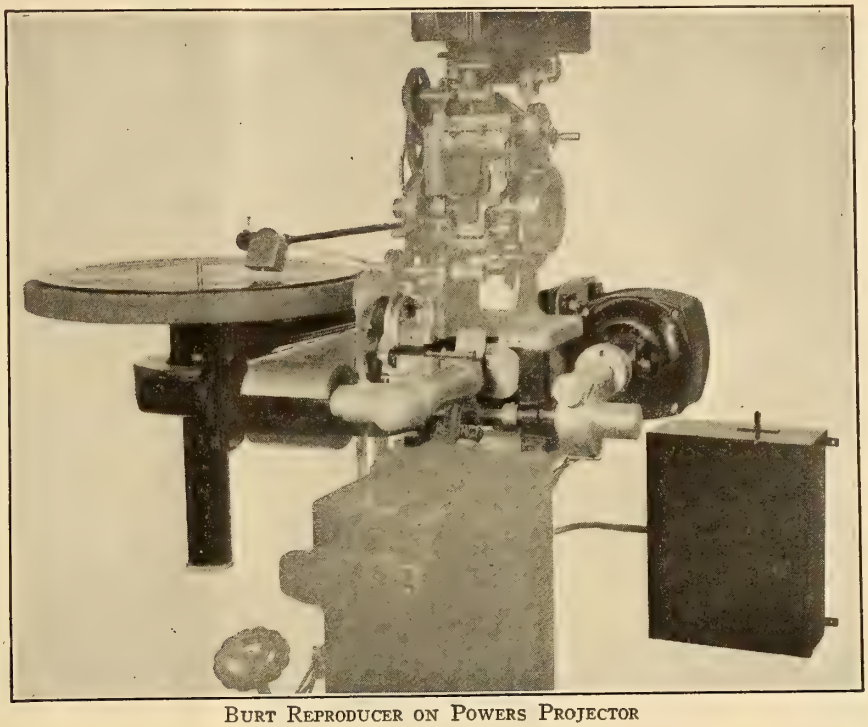
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Also Simon Terr, L. 306; Charles Thide, Lawrence Tiferlip, Int. Photog.; Lewis Townsend, Rochester, N. Y.; Charles Travis, Schenectady; Benjamin Turner, L. 306; Frank Vogel, L. 550; W. E. Waddell, Fox Grandeur; George Wedmeyer, L. 384; Lyle Wheeler, L. 306; William Widman, L. 306; H. C. Wille, S. Winick, L. 306; William Wolfe, L. 329; John E. Wood, L. 384; and H. Youngswick.

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The Macy Manufacturing Co. of Brooklyn, N. Y., announces a new style exponential air column horn for public address and sound reproduction purposes. This new type is known as Model S-72 and was developed for theatres and auditoriums seating less than 500. According to its makers, this latest horn development will give ample sound and is particularly suited for delivering excellent speech results.

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PROJECTOR HEAD is driven by its main drive gear and is not required to drive any part of the sound equipment.

ONLY THREE SHAFTS: (1) Motor Drive Shaft, (2) Sound Film Shaft, (3) Disk Table Shaft.

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Standard Nomenclature

(*Continued from page 22*)

photographic material. (2) The placing of any sensitive surface under the action of light.

Exterior—A scene supposed to be taken out of doors.

F

Fader—A potentiometer connected between the photo-electric cells of two projectors and the vacuum tube amplifiers, employed to change over from one projector to the other at the end of a reel. It is sometimes connected as an inter-stage coupling within the amplifier systems, and in some cases it is also used as a volume control.

Fade-in—The gradual appearance of the picture from darkness to full screen brilliancy.

Fade-out—The gradual but finally complete disappearance of the screen image. (The opposite of fade-in.)

Farad—Unit of measure of electrical capacity of a condenser. The usual unit is the microfarad, or one-millionth of a farad.

Feed Reel—The film reel from which the film is pulled by sprockets or other means before passing through the sound or picture reproducing or recording mechanism.

Film—The ribbon upon which the series of related picture elements is recorded.

Film-Gate—A movable element which, when in operating position holds the film in register against the aperture plate.

Filter Factor—The factorial amount by which exposure must be increased to give the same photographic effect when a filter is used as when it is not used. (Note: The quality of the radiation should be the same in both cases.)

Fixing—Making permanent the developed image in a film.

Flash—A short scene, usually not more than three to five feet of film.

Flash-back—A very short cut-back.

Flat—A section of painted canvas, light board, or the like, used in building sets.

Focal Length—The distance from the center of a simple thin lens to the image formed by it of a distant object.

Footage—Film length measured in feet.

Frame—(noun)—A single picture of the series on a motion picture film.

Frame—(verb)—To bring a frame into register with the aperture during the period of rest.

Frame Line—The dividing line between two frames.

Frequency—The number of repetitions per second of a regularly recurring phenomenon such as the alternations of potential in alternating electric currents or the vibrations which produce light and sound.

Fundamental—The natural frequency of oscillation for an electrical circuit or a material body.

G

Gain—The ratio of output energy to

input energy of an amplification system, usually measured in transmission units or decibels.

Gain Control—A device for varying the gain of an electric amplifier. The gain control commonly used in connection with sound reproduction apparatus consists of a pure resistance so designed that the gain can be varied in multiples of one decibel or one transmission unit.

Galvanometer — An instrument for measuring the intensity of an electric current, for detecting its existence, or for determining its direction. In some sound motion picture systems, the device which converts a variable electric current into an oscillating beam of light.

Glow Lamp—A lamp containing a gas which becomes ionized and glows when the potential between its electrodes reaches a critical value.

Graininess—The effect of inhomogeneity exhibited by silver deposits due to the presence of groups or clumps of silver particles.

Ground Noise—Any noise due to the foreign matter or imperfections in or on the film arising during manufacture, processing, or handling; does not include amplifier or photo electric cell noises.

Guide Roller—A roller, one flange of which can move in a direction perpendicular to the direction of film motion and so accommodate variations in width of the film.

H

Hue—Refers to the position in the spectrum of the dominant color quality.

I

Impedance—The property of an electric circuit which tends to oppose the passage of current. Impedance is the resultant of resistance and reactance.

Intermittent Sprocket — The sprocket which engages the film to give it intermittent movement at the picture aperture.

Insert — Any photographic subject without action, in the film.

Interior—Any scene supposed to be taken inside a building.

Iris—An adjustable lens diaphragm.

Irising—Gradually narrowing the field of vision by a mechanical device on the camera, or the projector.

J

Joining — Splicing into a continuous strip (usually 1,000 feet) the separate scenes, titles, etc., of a picture.

K

Kerr Cell—A device consisting of a pair of electrodes in a liquid which in an electrostatic field has the property of rotating the plane of polarization of a beam of polarized light (used in certain systems of photographic sound recording.)

L

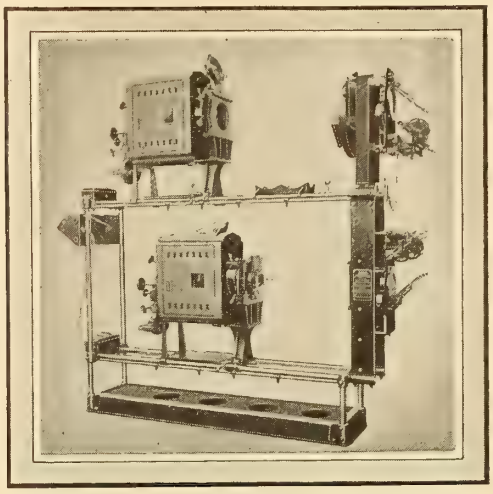
Lantern Picture—Stereopticon or lantern picture. A still picture projected on the screen by suitable means.

Lantern Slide—(Stereo Slide)—Stere-

(Continued on next page)

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Scranton, Pa., L. U. 329 Annual Banquet

THE annual banquet of Local Union 329, Scranton, Penn., was held in Casino Hall in that city on Sunday, November 14th. The affair was attended by more than 300 theatre workers, company officials, labor leaders and guests. Joseph F. Wynne, general chairman of the banquet committee, opened the program and then turned the gavel over to Frank E. Walsh, Secretary of the Scranton Central Labor Union, who proved an excellent toastmaster for the balance of the evening.

Employer Lauds Union

One of the principal speakers of the evening was M. E. Comerford, president of the Comerford Amusement Co., who pledged the cooperation of his firm in all dealings with union labor and who emphasized the important role played by union

(*Continued on next page*)

Standard Nomenclature

(*Continued from preceding page*)

opticon or lantern slide. A single transparent picture designed for projection.

Leader—That piece of blank film attached to the beginning of the picture series.

Lens, Simple—A lens consisting of but a single piece of glass or other transparent medium.

Lens, Compound—The combination of a number of simple lenses.

Light Beam—A bundle of light rays which has a cross section of appreciable size.

Light Ray—A stream of light of inappreciable cross section.

Location—A place other than a studio selected for a motion picture scene.

Loudspeaker—Device into which a varying electrical current is passed after suitable amplification and which transforms this varying current into mechanical vibrations, thereby producing sound waves. Similar to those producing the varying current.

M

Magazine Valve—The film opening in the magazine of a motion picture projector.

Marker—A device for marking the negative either photographically or mechanically for locating points of synchronism.

Martens Photometer—The chief example of a photometer in which polarization is used as a means for varying the brightness of comparison surfaces.

Masks—Opaque plates of various sizes and shapes used in cameras or projectors to limit the effective area of the picture.

Mechanical Filter—A mechanical impedance or a combination of mechanical impedances so designed as to pass or suppress mechanical vibrations of certain frequencies.

Micro-Prefix—Meaning the millionth part of, as in microfarad, micro-ampere, etc.

(*To be Continued*)

labor in the advancement of the Comerford amusement interests.

President Canavan Stresses Harmony

President William F. Canavan of the I. A. T. S. E. charted the progress of Local Union 329 since its formation and congratulated its officers and members for their initiative in the matter of promoting goodwill between their employers and themselves by their consistently good work and fair dealings. Other speakers were Attorney Frank C. Walker, counsel for the Comerford Amusement Co.; M. B. Comerford and John J. Galvin, both of Wilkes-Barre; and Boone Mancall, publisher of THE MOTION PICTURE PROJECTIONIST. Handsome gifts were presented to the following I. A. officials: President Canavan, Secretary-Treasurer Green and Representative Louis Krause.

Local members present at the affair were Joseph F. Wynne, George R. Miles, James Armstrong, Samuel Kessler, William Wolfe, Frank Koch, Robert O'Connor, Robert Dimmick, John DePeep, John Durkin, Glen Oinstein, Harry Stevens, Lester DeVol, John Korkobecz, Fred Hopf, Thomas Davis, Morgan Walters, Lawrence Linen, Vincent Constanzi, Joseph Namitka, Harry Litts, Franklin Francis, Charles Terotto, Anthony Bianco, Richard W. Jones, Robert Jeffrey, Rocco Terotto, James Merrick, Joseph Dubish, William Kelly, Chris Armstrong, Harry Granville, Jr., Ralph Longo, Louis Chimino, Edward Friedman, Harold Prosser, Thomas Davis, Jr., Harry Granville, Sr., Gerald Lafferty, William Pantle, Joseph Smith, Edward Miles, Edward Pantle, George Drobnak, Donald Ball and Angelo Grecco.

Delegates from more than a score of neighboring Local Unions were present at the affair, in addition to representatives from other trade unions.

Famous Workers in Light

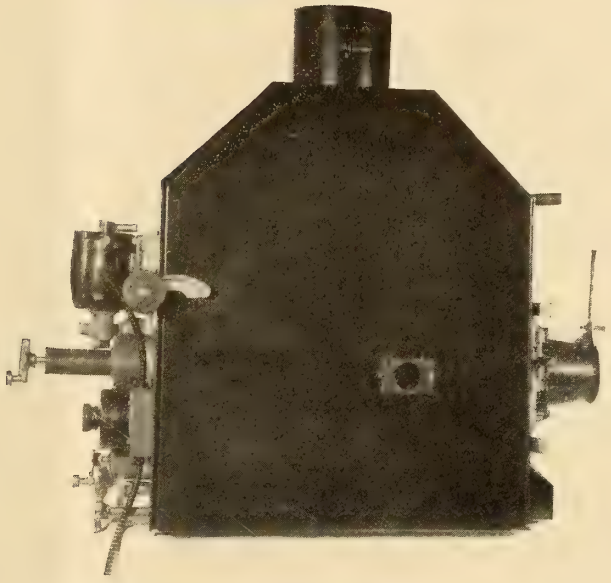
Have you ever wondered what makes the many-colored band of light around an object? The colors that appear in the beveled edge of a mirror? Or the broad, color-circles around a light bulb? It can't be direct reflection of color from the object glass or lamp—when that is white.

White light contains all colors. Passing through glass, or reflected from any surface, rays are bent. In criss-crossing each other, the light rays obliterate parts, sometimes all, of each other. Two white rays strong in red, may kill the red in each when they cross—and, white with the red taken out, becomes green! Thus, a white body might have a green halo from its own reflected rays. This knowledge the world owes to Dr. Thomas Young, of London.

Newton's idea that light was an emission of particles from the light source was exploded by Young's investigation. Dr. Young said light, like sound, was conveyed by waves set up in the air. Just as two sounds may unite to make one louder sound, or as one sound may drown out another, two light rays may act similarly. When, as we showed at the beginning of this story, one ray destroyed a color in another, or all of another, Young called it "interference"—really a dark spot created in the light by the uneven qualities of the rays.

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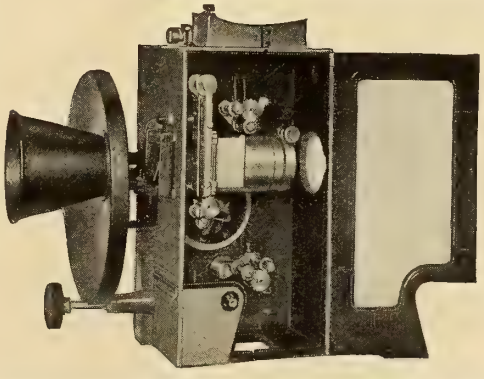
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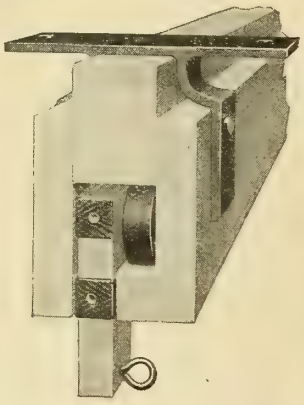
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"Super-Speeded" Speech In Unique Demonstration

CHANGING the rich bass tones of a man's voice to a high pitched musical jingle; completely reversing human speech and inflection; and a motion picture of a movie film sound track, with the accompanying sound this track represents heard simultaneously, were some of the new effects demonstrated before a recent meeting of the New York Electrical Society by John Bellamy Taylor, consulting engineer of the General Electric Company. Other unusual effects included the transmission of speech over a beam of light, the use of a neon light as a short range "narrow casting" station, the production of sound from the effect on a photo electric cell of the flicker (too minute to be detected by the eye), in the rays of a flashlight, and the production in a similar manner of sound created by the light variations in a burning match.

Super-Speeded Speech

Super-speeded speech was a spectacular effect made by greatly increasing the rate at which normally recorded speech is reproduced. Mr. Taylor used a talking movie film sound track of a man's voice. He reproduced this at normal speed with its low throbbing pitch. As he increased the speed at which the reproducing apparatus operated, the voice came through in a higher pitch and much clearer. As the speed was increased to one hundred percent above normal the words ceased to be intelligible. At three times normal speed there was no sign of words or inflection,—nothing but a high pitched musical phrase.

A unique method of transforming the sound track record on the film into speech was used by Mr. Taylor. Ordinarily the transformation is made in the projecting machine where a tiny beam of light shines through the sound track and directly into an adjacent photo electric cell. The sound track in the system shown may be described as having a serrated edge and being of variable width. This variation in width of the transparent portion controls the amount of light that passes through the film and this gives a current of corresponding variation in the photo electric cell.

Mr. Taylor projected this sound track onto the screen, where it produced a visual image of the voice, made up of its varying widths of light and shade. There was a slot in the screen, and as the varying widths of light and darkness passed over it, varying amounts of light were passed to a reflector working into a photo electric cell pick-up actuating in its turn a loudspeaker unit. In this way the image on the screen was the controlling element in reproducing the voice.

Transmitting Over Light Beam

Picture of this voice record and of other sounds were thrown on the screen, and Mr. Taylor was able to show how the quality and intelligibility of these changed by increasing or decreasing the width and position of the slot which allowed selected and restricted portions of the sound track to act on the photo cell.

"In transmitting speech over a light

beam," said Mr. Taylor, "I use a constant source of light focused on a mirror one thousandth of an inch square. This tiny mirror is delicately suspended in a magnetic field by means of wires. The sounds to be sent over the light beam are picked up by a microphone or a magnetic pick-up from a phonograph, and are changed into electric impulses. The variations in the sound cause corresponding changes in the electric current. This current is amplified and passed through the wires on which the mirror is suspended. The changes in the current cause the mirror to quiver and to focus varying amounts of light on the lenses that form the beam.

"This light beam is thrown upon the distant photo-electric cell light pick-up device. A target lens concentrates the light upon the cell, wihch responds promptly to the infinitesimal 'flicker' in the light source caused by the sound variations—a flicker so small that it is imperceptible to the human eye. The cell translates the light back into electric current, pulsating according to the light variations. These electric impulses are passed through a vacuum tube amplifier and then to a loud-speaker, where they are brought out as the same song, speech, or other sound which actuated the distant transmitter."

By a wave of his hand Mr. Taylor was able to command silence from his device or to produce a full blast of song. Placing his hand in the path of the beam shut off all transmission. By opening his fingers slightly or spreading them wide he was able to let a small or larger amount of light filter through to the receiver and thereby control the volume of sound. He showed how a man could, with grace and dignity, eat his own words. He did this stepping into the path of the beam as he spoke into the microphone, and letting the light shine into his mouth. His words, which started out as sound waves, came back a very small fraction of a second later as a modulated light beam, and ended where they began.

Reversing Human Speech

Reversing human speech and inflection as demonstrated by Mr. Taylor produced a new language. A movie sound track film was used in this demonstration. The reversed speech effect was produced by feeding the film through the reproducing apparatus in the reverse of the normal direction. Mr. Taylor's name became "Orlayt," and other surprising effects puzzled the listeners trying to translate the strange jargon.

A freshly lighted match held in front of the photo electric cell caused explosive clicks, like "static," in the loud speaker. These corresponded, not to the sound of the burning match, but to the varying intensity of the flame created by the chemical action that ensued as the substances in the head of the match were consumed. When the flame reached the wooden stick the loud speaker remained almost silent.

A pocket flash light containing a small hand-operated dynamo for its current supply, seemed to give a steady light; but when this light was thrown on the photo-electric cell the audience were startled to hear a screeching sound not unlike that of a siren alarm on a fire truck.

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THE editors of THE MOTION PICTURE PROJECTIONIST solicit your aid to the end that this publication may be of the maximum service to you. Every subscriber can do his bit to improve this service by using the space provided below to indicate his preference for special articles and other material in which he may be particularly interested.

Let us know your preference, please. All requests will receive attention in the order of their receipt, so act quickly. Use the blank below to tell us in just what subject you are particularly interested. Do it now!

Editor,
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New German Optical Projector

A NEW "non-stop" projector is to be introduced to the European trade shortly by the German firm A.E.G., one of the biggest electrical firms there, and one associated with Klangfilm, sponsor of a sound picture apparatus which is proving very popular in Europe, according to a report submitted by the American Trade Commissioner at Paris. This new projector aims at solving the problem of non-intermittent projection. A.E.G. claims for this new machine a wide margin of superiority over the mechanical intermittent projector in that there is no film damage or projector part damage with the optical projector. Further, it is claimed that the light transmitted by the optical projector is 100 per cent., none being wasted by the intercepting action of the shutter which is employed with all mechanical intermittent movement projectors.

Demonstrated in America

The A.E.G. projector makes use of a series of mirrors. Each of these in turn moves on its axis as the film travels through, so as to keep the image of each picture reflected on it in the center of the screen. There are a number of these mirrors, which move into place one after the other. The projector has already been installed experimentally in several European film houses, according to the report, the results of which tests will determine the marketing plan for a large number of these projectors.

A description of an optical projector appeared in the January, 1929, issue of THE MOTION PICTURE PROJECTIONIST, excerpts from which are included here so as to promote a better understanding of the working of the new projector reported above. It is not generally known that an optical projector was installed in the Capitol Theatre in New York City in 1926 where it functioned efficiently for several months. It is understood that the lack of assurance on the servicing of the projector, if needed, prompted the directors of the Capitol Theatre to have the equipment removed. The optical projector which was described in these columns was the product of the Mechau Works, Germany, excerpts from which description follow:

. . . Experiments have been carried on for a long time in an endeavor to eliminate the shutter and to run the film continuously. The experimenters proceeded along this line of thought: If you throw with an ordinary mirror the light of a candle on a white wall, the reflected picture will move as soon as the mirror is moved. But if the candle moves with the mirror, it is possible to keep the light steady on the wall. This phenomenon is known as the principle of "optical dissolve."

In place of the light source imagine the illuminated film picture and you have thus mentally constructed a projector fashioned after the above principle. As simple as this principle may appear, just as difficult is its application. Only one firm has thus far been successful in placing upon the market a projector of this type (Mechau Works, Germany).

In this projector there are eight visible mirrors which turn around a main axis. These mirrors, while revolving, are also undulating, or rocking. To this end they are connected to a curved ring on which they are guided. The movement of these mirrors must of necessity coordinate with the movement of the film to gain a satisfactory result, as the smallest difference produces a hazy picture and poor definition.

Recently several improvements have been effected in the optical system of the Mechau projector. To improve the picture and to reduce light losses the rays passing the aperture are moving with the film picture by means of the rotating and rocking mirrors. . .

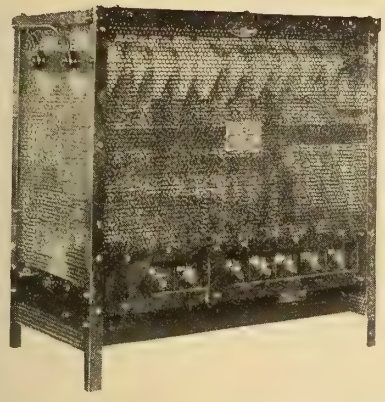
New R C A Equipment

RCA Photophone announces that their new sound equipment, to be known as "Type G," will definitely be on the delivery schedule for December, as promised. Factory production is proceeding at top speed to complete a large first order for December contracts. More than 1,500 men are working on the "Type G" equipment at the Schenectady plant of the General Electric Company, and approximately 1,200 are operating full schedules in the great East Pittsburgh plant of the Westinghouse Electric and Manufacturing Company. Both manufacturing associates of RCA Photophone will be required on steady factory schedule from now until December to complete the first delivery of the "Type G" reproducing system.

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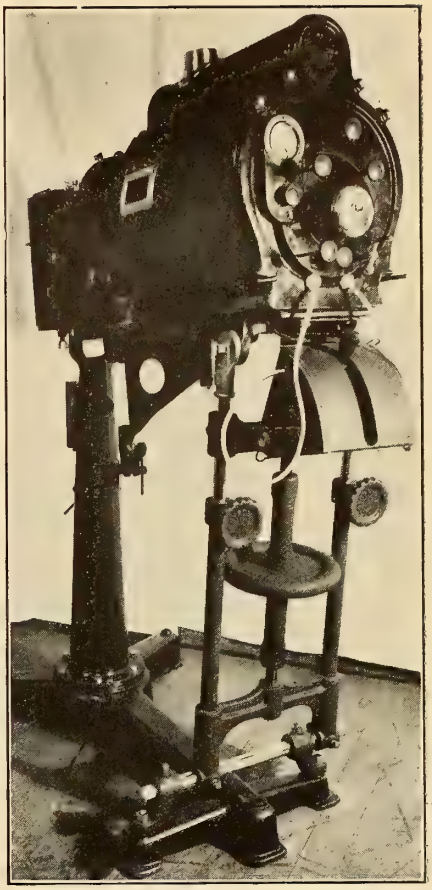
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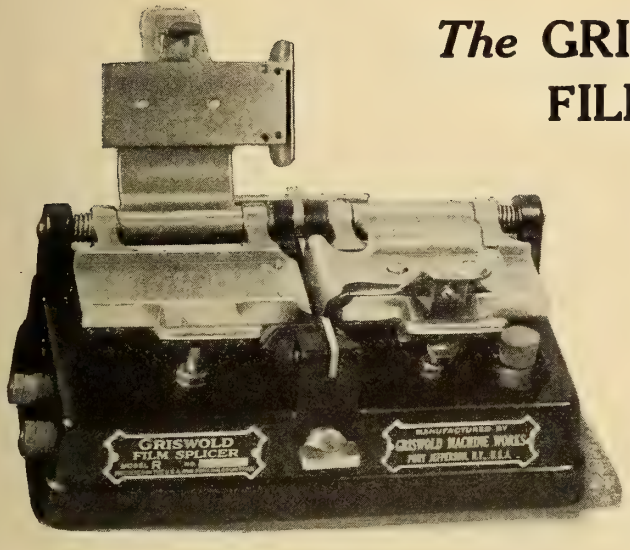


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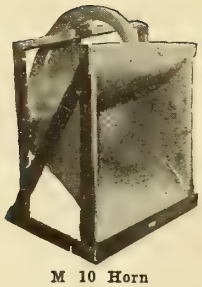
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Machine Power Increase 50% in Decade

MACHINE power is increasing more rapidly than man power in manufacturing plants of the United States, it is indicated by a study of the growth of horsepower in proportion to workers made from records of the United States Census Bureau.

Horsepower employed in industrial production now averages about 5.0 per worker taking the country as a whole, it is estimated. In 1927 the ratio was 4.7 horsepower per man, the census reports reveal. In 1919 it was 3.2 horsepower.

The increase in the last decade it is thus seen amounts to more than 50 per cent.

The growing use of mechanical power in industry tends to substitute machines for men and thus deprive many workers of their jobs, it is claimed. The process is held to be at the bottom of at least part of the problem of unemployment.

Results of Mass Production

Machine methods, it is pointed out, on the other hand speed production and enhance the productive efficiency of the great body of workers. Mass production and large output per worker in the American economic scheme form the basis of high wages and a rising standard of living for the workers as well as the country at large.

The constant process of industrial expansion and readjustment tends also to create new jobs for those thrown out of work by machine processes, and this, many contend, operates to maintain the balance more or less even.

West Coast A. P. S. Active

California Chapter No. 7 of the American Projection Society, with headquarters in Los Angeles, bids fair to surpass any single body now engaged in furthering the campaign for projection education. No less than three publications are subscribed for by the Chapter for its members, in addition to three text books on various phases of projection work, sound pictures, electricity, etc. The Chapter also has several tie-ups with various agencies which furnish the membership with reports on the very latest developments in scientific circles.

The unique feature of this educational campaign is that the necessary arrangements for all educational material, lectures and demonstrations are handled by the Secretary, who is constantly in touch with activities in all branches of the industry. David Koskoff is Secretary of Chapter No. 7, and he has followed up his fine work of last summer on the standard aperture size survey with equally as good work on behalf of his brother members.

Tube Contacts

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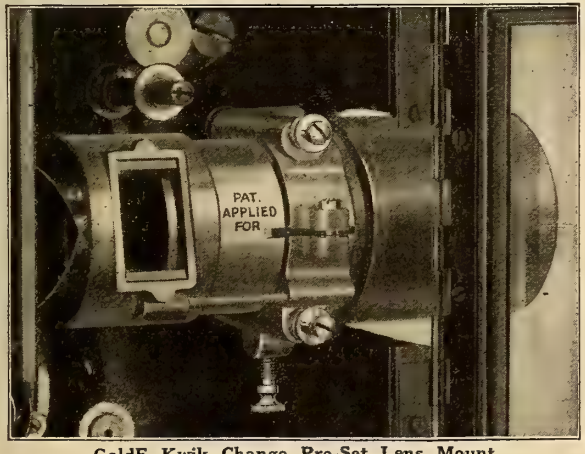
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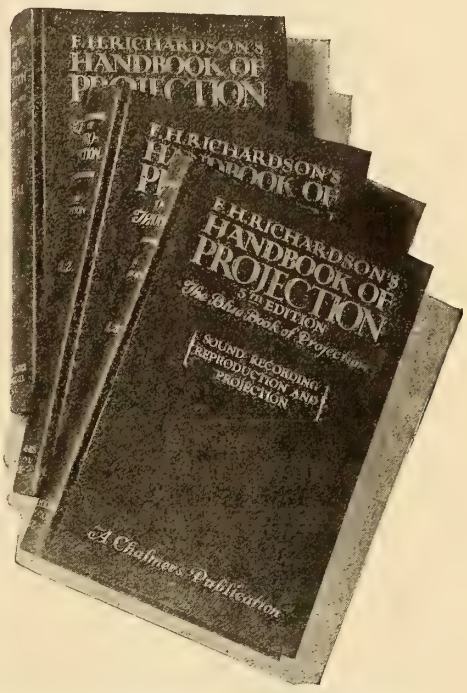
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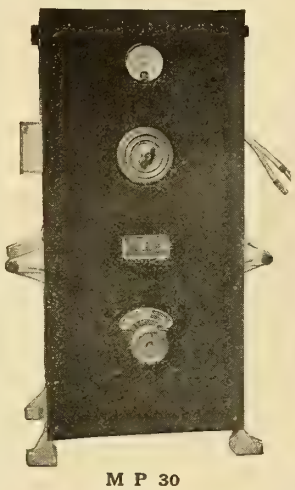
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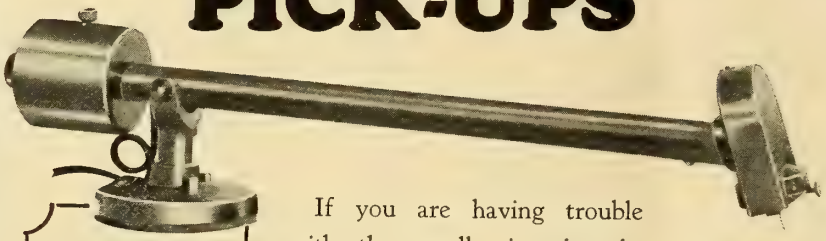
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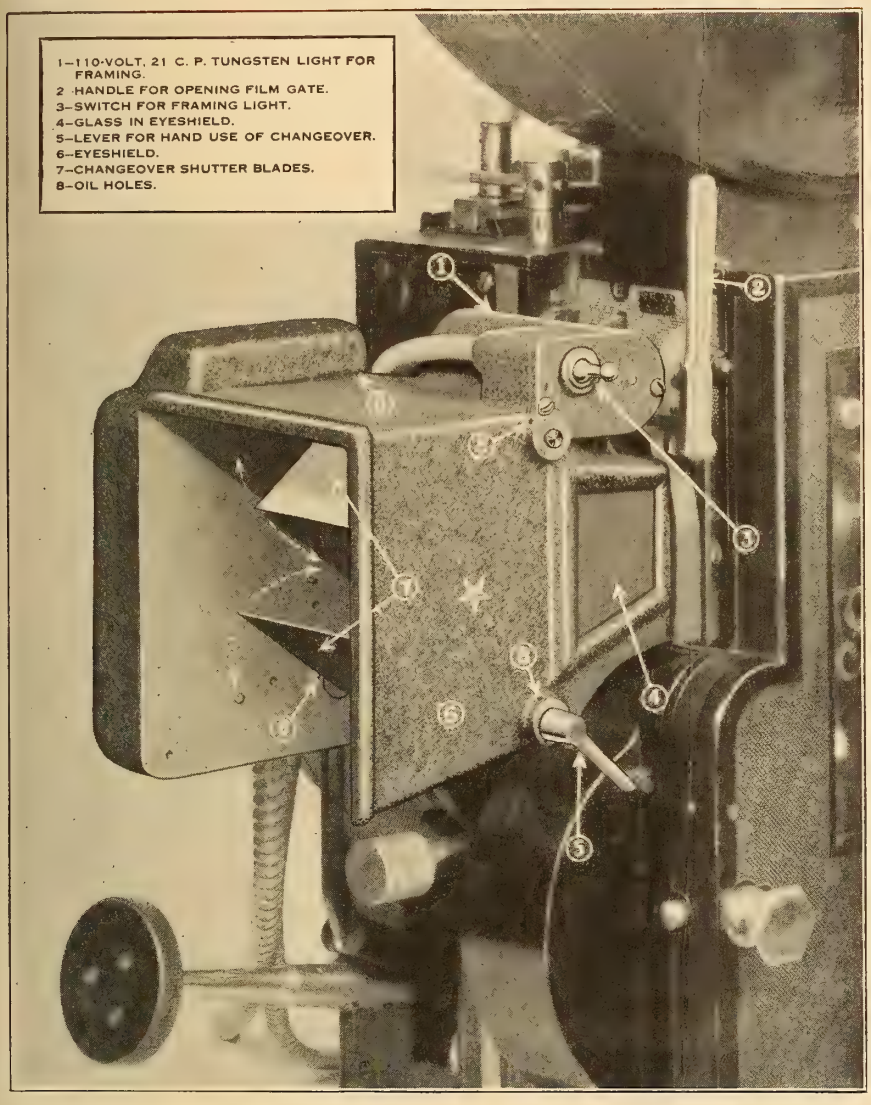
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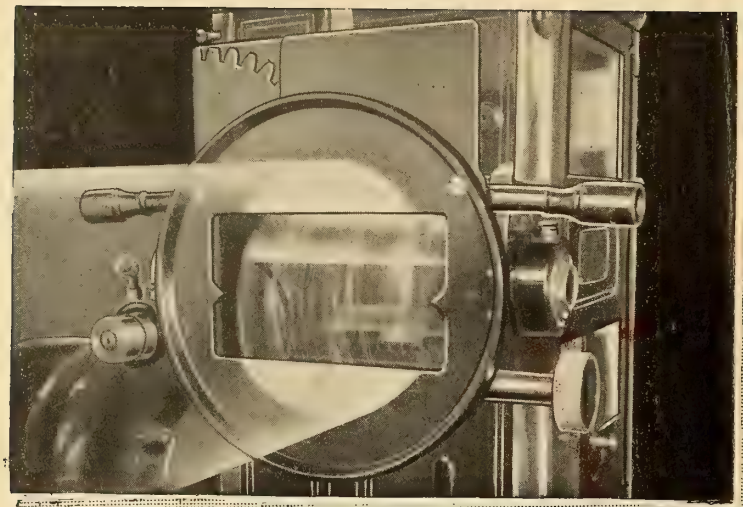
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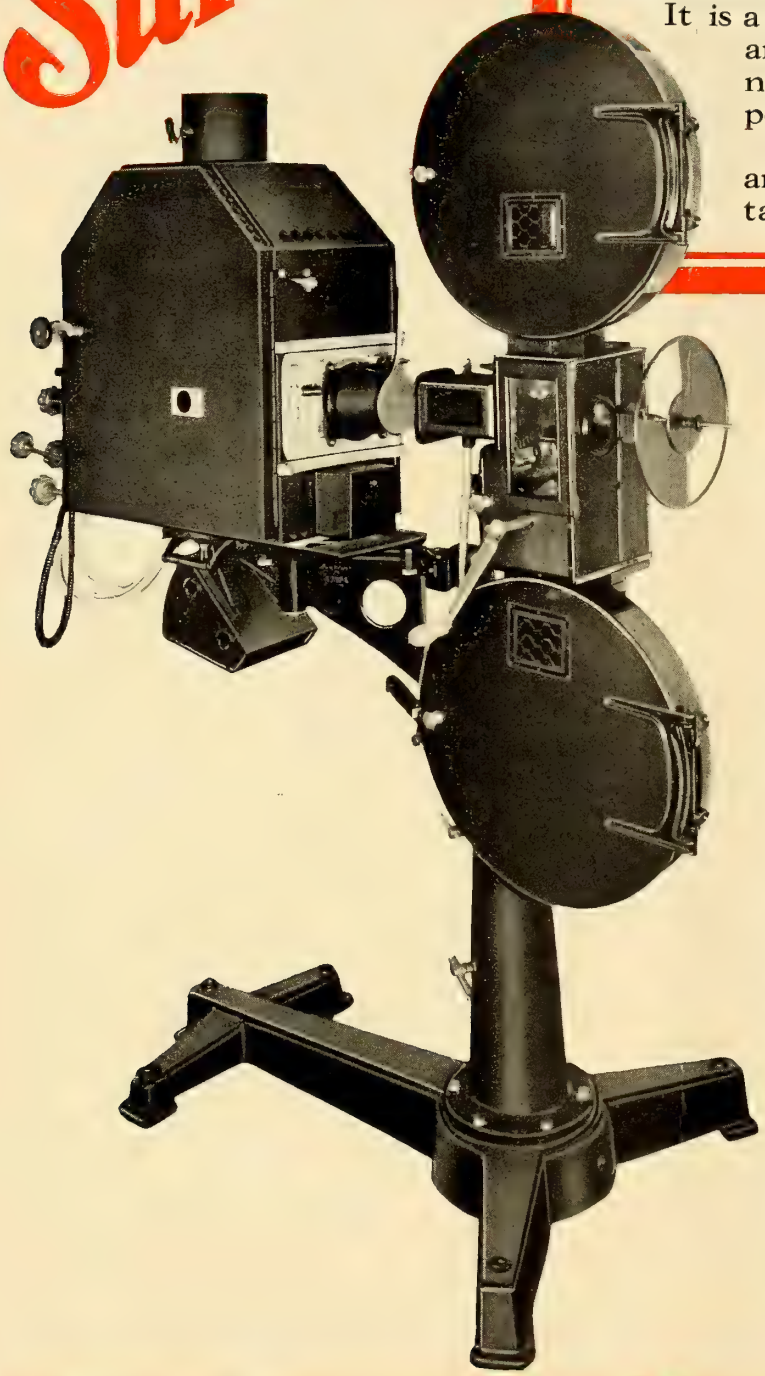
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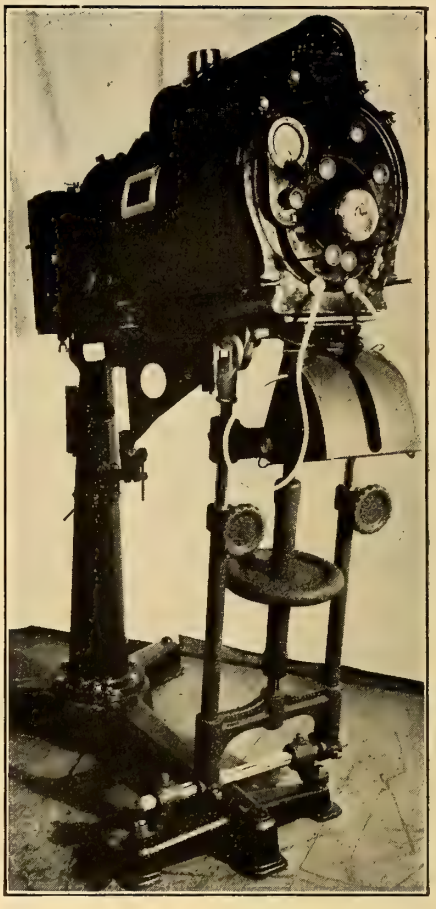
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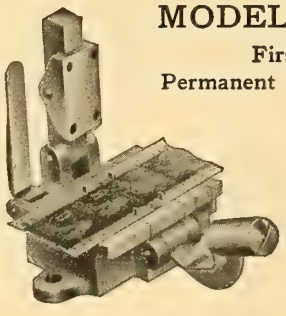


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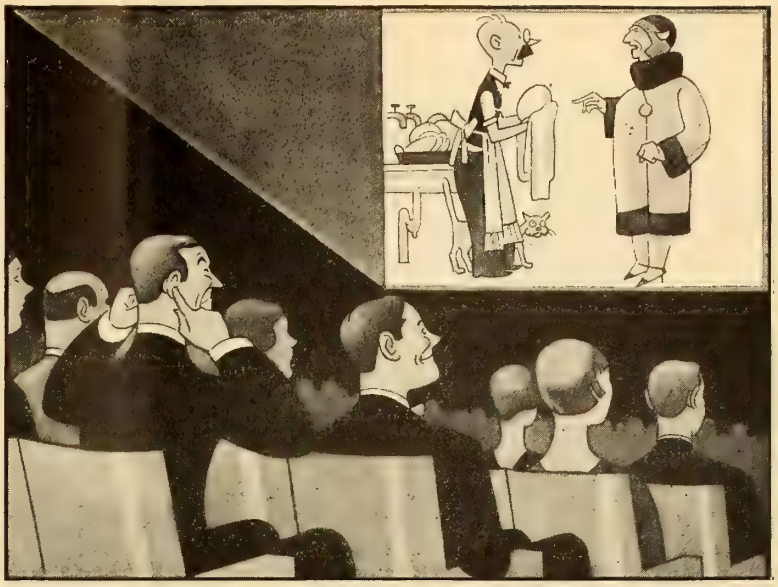
3. Experience under actual working conditions; for example, data of work output, mistakes, spoiled work, etc., in actual factories or offices under different levels of illumination, all other conditions being kept as nearly identical as possible.

4. Figures now accepted by experienced lighting engineers as "good practice" levels; it being reasonable to assume that these figures indicate the average experience of competent lighting experts tempered by practical considerations.

5. Computations from the characteristics of the light-perceiving elements (rods or cones) in the retina of the eye; the basic theory being that these elements probably differ among themselves in sensitivity to light and that ideal illumination should provide enough light to allow virtually all of them to operate, so that visual efficacy may be as great as possible.

6. Comparison with average outdoor lighting levels in daylight; under which it is reasonable to assume that the human eye evolved and which the eye reasonably might be expected still to require for best seeing.

The classical experiments on visual acuity are those of König published in 1897. Later experiments, more comprehensive and believed to be more accurate, have been published by Luckiesh and his associates at Nela Park; by Ferree and Rand, late of Bryn Mawr and now of Johns Hopkins, and by many others. All of these investigations agree, within reasonable limits of uncertainty, that visual acuity increases very rapidly with increase of illumination up to between 10 and 20 foot-candles. Thereafter there is a lesser but still important increase up to about 100 foot-candles. There may be further increases in average acuity for increases of illumination above 100 foot-candles but so few experimental investigations have been made that nothing is known with certainty.



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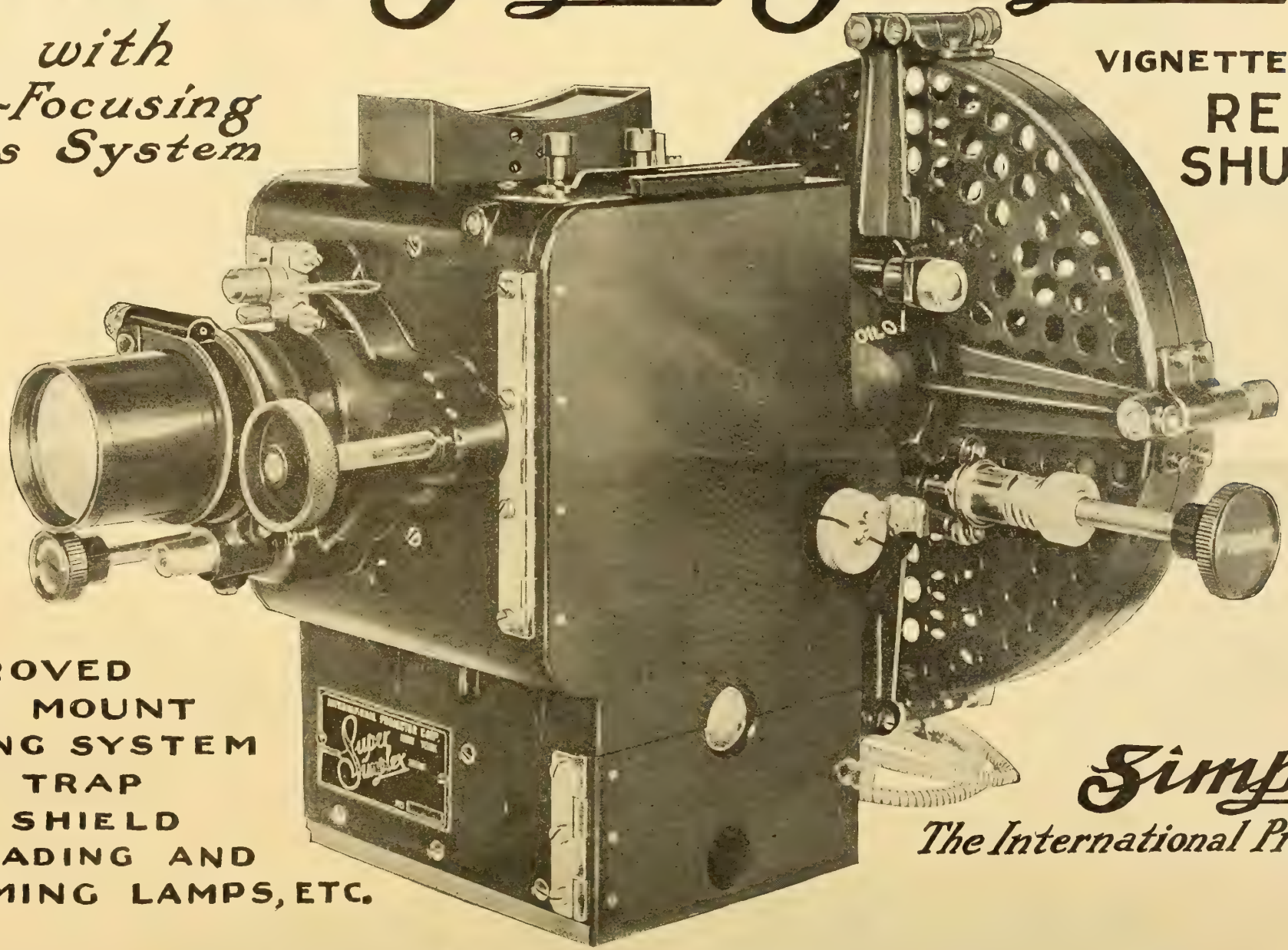
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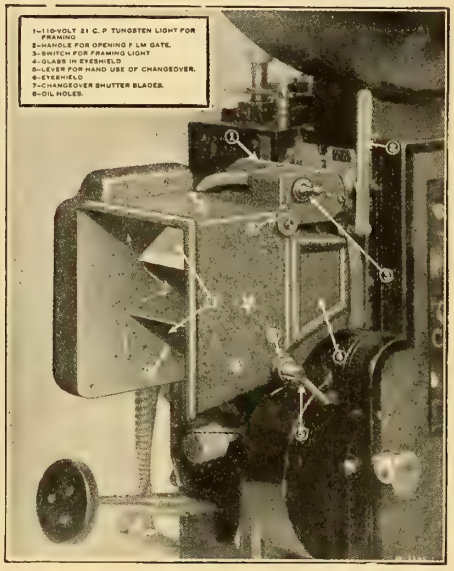
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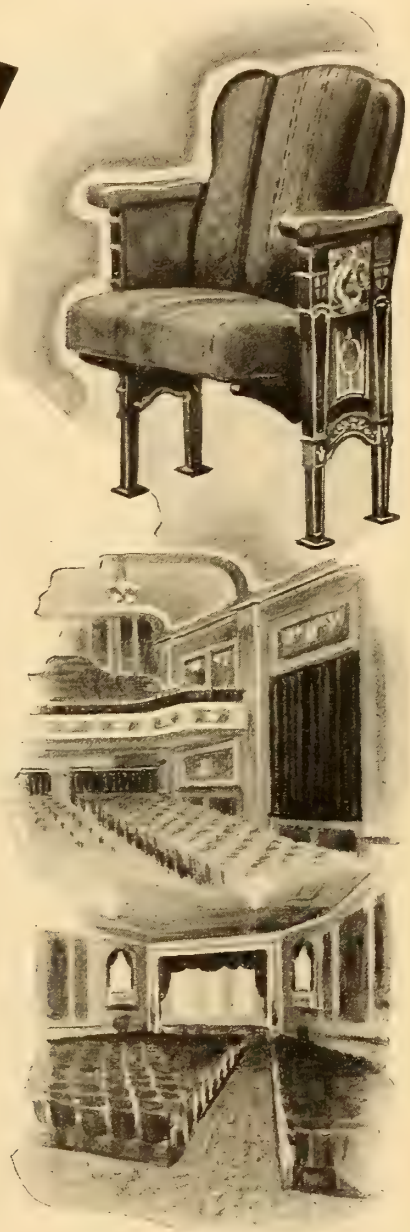
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"So Paddy says, when we got outa the place. 'Pretty good sho, wasn't it, kid?' and I says, 'I'll bite, was it?' (How should I know if the show was good if I couldn't hear what it said?) 'Listen, sap,' I says, 'I know my talkies and where to go to hear 'em.'

"'Oh, is **zat** so?' he says. 'Poisonally, I tought it was a swell pichure.'

"'Oh, yeah', I says, 'well **you would** because in the first place, if I got any memory a tall, your mind wasn't at no time on the pichure, and furthermore,' I says, 'don't never ask me to come back here to take in another of your swell talkies in the silent. I simply gotta take my art straight or not a tall.'"

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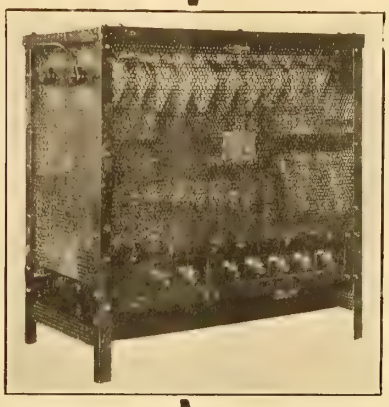
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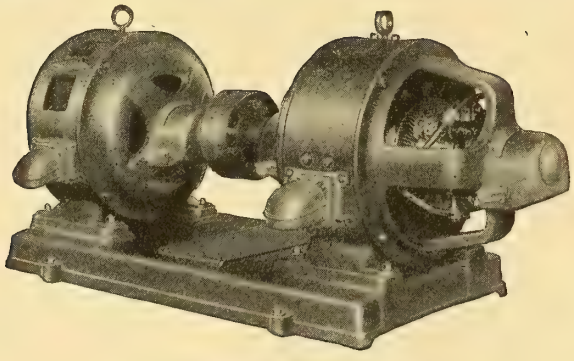
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Audio Amplifier Applications

By J. L. WHITTAKER*

VERY few of us realize just how important a role is played by amplifiers in our daily lives. Until the advent of sound pictures and their rapid acceptance by the theatregoing public, practically the only occasion on which the average person realized the existence of such a thing as an amplifier was when something went wrong with his home receiving set and he was forced to call in the local "expert." Actually, however, the use of amplifiers for radio reception constitutes but a small portion of the work performed by these versatile units.

For example: we use our telephones constantly, occasionally making long distance calls thereby, yet we rarely consider that without amplifiers communication by telephone would be limited to very short distances. Often we tune in our radio sets to programs which are being broadcast over nationwide chain hookups. Here again the amplifier is the heart of this whole complicated engineering problem.

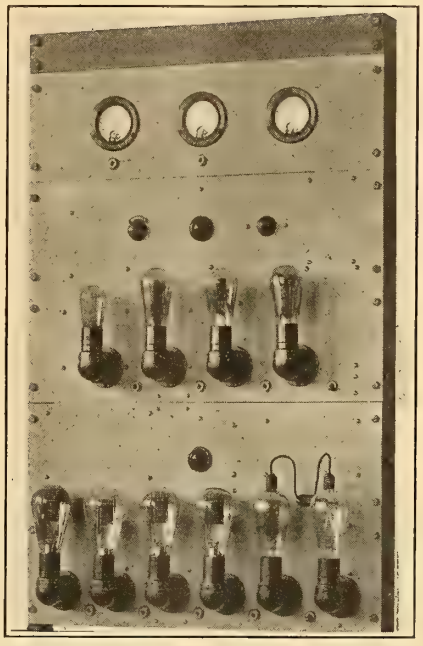
Ever since the development of the vacuum tube as we know it today, the best electrical engineering talent in the world has been busied with experiment and research to discover and develop the many possibilities of the amplifier. Easily the most difficult problem encountered by these workers is that of effectively harnessing the output of these vacuum tubes and setting it to do the required work.

High-Power Units

It is only within the past few years that extremely high-power amplifiers have been found necessary. One of the outstanding applications of large power amplifiers is their use in sound picture work in theatres. The function of the amplifier is rather well known to readers of these columns, that is, insofar as it applies to its faculty of increasing a small electrical current sufficiently to actuate one or more loudspeakers and thus produce sound. It is customary to have two or more independent amplifiers of equal characteristics, with the size of the amplifier being largely determined by the size of the theatre or auditorium.

Despite the claims of several sound equipment companies in the motion picture field that their apparatus is good yet cheap, it is generally agreed among those who are in a position to know best that only the very highest grade equipment is suitable for sound reproduction in a theatre, and this applies to the amplifiers as well as to the balance of the equipment—pick-ups, speakers, photo electric cells, etc. The acoustical characteristics of the auditorium is also an important consideration, but as this presents as many individual problems as there are theatres, it need not be discussed herein.

In the last few months another great field has been opened wide to the amplifier, a field to which few of us give little thought, namely, program distribution systems for hotels and other large institutions. A typical hotel amplifier installation



Typical method of combining a group of standard units to take care of special requirements

uses two or more independent power amplifiers, each of which are large enough to adequately supply every room in the building, if required. A receiver is provided for each room, and phonograph programs can be substituted for the radio. Each guest room is provided with a loudspeaker as well as with a switch for selecting any one of the programs available. A volume control is supplied.

When it is remembered that many hotels have more than 1,000 rooms, it is obvious that an amplifier to supply such demands must be of considerable size and of a quite complicated nature. This particular amplifier application naturally calls for a great deal of special work in order that the particular problems of each individual installation may be solved.

The usual custom in operating installations of this kind is to place at the disposal of each guest two or three different types of programs. At times when there are no suitable programs available, phonograph music may be reproduced electrically and distributed in the same manner as the radio programs. Still another source of entertainment is embodied in the many orchestras which are resident at various hotels, and in cases of this sort it is merely necessary to connect microphone equipment to the amplifier.

Difficulty on Standards

As previously stated, this type of equipment requires much special study and design work by the installation engineer in charge. The large majority of standard equipment available is very poorly suited for this special type of work. Simply because a certain manufacturer can and does make a good power amplifier (and this in itself is a real problem), is no indication that he is in a position to handle large program distribution systems, or, in many cases, able even to specify the type of equipment which should be used.

Requisite for this type of work is the maintenance of a large staff of research men and not a few field engineers. Because of the many problems involved, it is practically impossible for any manufacturer of equipment to standardize his equipment to any great extent. The best solution to this problem appears to be provided by the suggestion that all equipment be designed on a unit basis, each unit to be as flexible as possible. In short, instead of building a number of complete units suited to what may be termed average requirements, it would be much more satisfactory for the manufacturer to place a fairly large variety of amplifiers, mixing panels, radio equipment, speakers and special circuits at the disposal of his field organization. With cooperation of this sort, the field organization can survey a prospective site and specify standard equipment which will meet all the requirements of the situation.

The use of amplifiers for public address system use is another highly specialized field. The problems encountered by the field organization here far outweigh those of the first problem of multiple receiver units. Future developments in the electro-technical arts—in radio, sound pictures, and television—undoubtedly will show the way for many new adaptations of amplifying equipment. All three branches of the art undoubtedly will show steady improvement, and it is a certainty that the development of amplifying apparatus will mark the way for these advances.

The foregoing is merely to show the general utility of the amplifier in its many forms. With the present activity within the radio field, one need not be surprised to see very soon many radical departures from present amplification standards.

*Consulting Engineer, Webster Electric Co., Racine, Wisc.

Equipment Troubles and Maintenance

By C. R. TRAVIS

DISC reproduction troubles were extensively treated in the last installment of this series of troubles and maintenance, thus in this third article of the series we shall discuss the more common troubles which are encountered with film reproduction, and we shall begin with the sound head. As previously stated, one must know his objective before he can successfully check his sound equipment for troubles, and this knowledge may be gained only through the practical application of certain information which has been gained from sound equipment over a considerable period of time.

The sound head is a device for accomplishing two things: (1) To cause sound film to pass a given point at a constant predetermined speed and to hold it steady in two planes at right angles to the plane of normal motion:—it being understood that the given point is the light beam. The constant speed, according to present standards, is ninety feet a minute. The two planes refer to the absence of any motion which will tend to move the sound track from side to side or permit the film to buckle or get out of focus with the focal point of the light beam. (2) To transform the recorded sound on the film sound track into electrical energy.

Mechanics of Sound Heads

Let us first consider the mechanics of the sound film head and endeavor to analyze the entire assembly. In order to insure a constant speed in the projector drive it is necessary first to have a source of constant power, either mechanical or electrical. The electrical power fluctuations, particularly in small cities or in those cities which are supplied with power from a remote source, precludes the possibility of using any type of motor that depends upon voltage for its speed. One of the larger distributors of sound equipment in the industry even goes so far as to install a special motor generator and control box in order to insure a constant speed for the motor equipment.

In its simplified form, this system starts out by lowering the effective line voltage entering the motor to about 95 volts and then, by means of the generator, either adds to or subtracts from this voltage to keep the motor within limits. This system will hold the motor speed within one-half of 1 per cent for a 10-volt change in line voltage, irrespective of the speed of change. This particular equipment has been designed to meet the demands of all types of alternating and direct current power installations. An examination of the brushes and commutators, with an occasional changing of the tubes in the control box, will keep this equipment functioning satisfactorily.

With regard to 2- and 3-phase alternating current power, synchronous motors lend themselves to the problem admirably, and by using a slightly heavier motor than is usually required for the work, they will give wholly satisfactory results. This type motor does not depend upon the voltage and current characteristics of

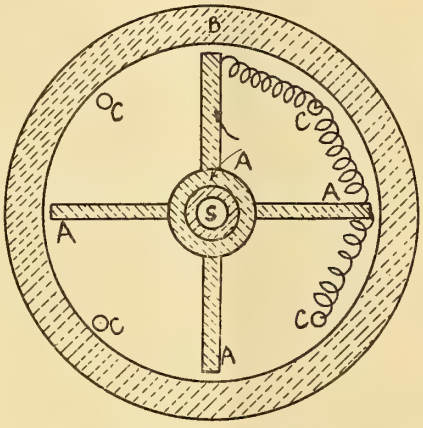


Fig. 1—In this type filter system power is supplied to sound head at assembly *A*, which is allowed to rotate on shaft *S*. *C* represents pins or hooks mounted to a flywheel. Springs connect between assemblies *A* and *C*. Thus, any tendency by *A* to give short, quick speed changes will be resisted by the flywheel and the difference absorbed by the filter springs. The sprocket or drum handling the film is connected solidly to flywheel by means of shaft *S*.

the power supply, insofar as fluctuations are concerned, but rather locks in the phase characteristics of the power and may be imagined as being similar to a gear properly meshed into another gear representing the phases of power.

Motor Overloads

In the case of a motor that is badly overloaded or too light for the task assigned it, there will be a "slip" in which the motor will in effect break the theoretical teeth that are holding it in phase, with the inevitable result of speed variation. Personal experience with this type of motor seems to indicate that ¼ h.p. motors give the best results; while on a free-running projector and sound head, 1/6 h.p. motors will give good results, but the margin of safety is not very great.

On single-phase installations a synchronous motor should be equipped with a heavy flywheel to assist it in maintaining the proper speed or at least to prevent it making radical and abrupt departures from uniform speed. One type of motor that has been used with considerable success on single-phase work depends upon two windings, one of which is designed to supply the power and to run slightly faster than the desired speed, while the second winding (synchronous), is superimposed on the other and acts as a brake to hold back the first winding. This motor is further stabilized by a flywheel. The motor naturally heats up considerably, but the writer has yet to hear of any of them failing.

Direct current motors existent today are dependent upon a heavy flywheel to prevent any sudden change in speed.

Transmission

In some systems transmission is accomplished by direct connection, but due to the vibration to which the sound head is subjected, this method has not proven wholly satisfactory, and the motor usually is removed to a more remote point.

One of the larger sound equipment manufacturers locates its driving unit on the floor, and connection to the sound head is made by means of two sets of bevel gears and two universal joints connected by means of a shaft. The variation in speed due to lost motion in the gears and universal joints is prevented from reaching the driving element in the sound head by means of a spring drive connected between the shaft of the sound head and the main drive shaft. A glance at the accompanying sketch (Fig. 1), will show that any reasonable amount of play in the gearing or universals will be taken up by the springs in their ability to rapidly change the speed of the stabilizing flywheel.

Types of Drives

Other systems use the standard motor base, and use either chain, belt or gear shaft drives. Chain drives work satisfactorily if properly designed and adjusted and providing ample allowance is made for wear. In all cases the drive shaft of the sound head must be flywheeled. Belt drives, while offering perhaps the greatest factor of safety to the projector head in the event of the head "freezing", are the most unreliable in all other respects. "V-type" belts offer the best solution of many problems, but they also occasion considerable trouble in the matter of design and manufacture of pulleys and belts to obtain proper speed.

Gear and shaft driving, judged by results obtained, are by far the best, but as used today they offer no pro-

tection to the projector in the event of a "freeze-up", and great care must be exercised at all times to keep the projector working free and easily. All types of friction drive have come to our attention, but as yet we have seen none that is entirely practicable, for the reason that with the present trend toward "all sound" shows, there appears to be no further use for them. The best results are invariably obtained when the main sound head drive is properly flywheeled and filtered.

Film Advancement

Two methods are in use today to pull the film past the light beam. (1) The most common method is that of pulling the film through or over a gate or aperture by means of a sprocket usually attached to the main drive shaft of the sound head (2) The film is wrapped around a drum with the edge on which the sound track appears being exposed to the light beam (RCA Photophone). This drum replaces the sprocket and is driven by the main drive shaft of the sound head. A compensating device to either slow down or speed up the film as it comes through the projection gate is required to allow for variation caused by film shrinkage, due to the drum having a constant periphery and no teeth to engage the sprocket holes of the film. In both cases the film is guided to its proper location by means of guide rollers.

Sound heads in general occasion much trouble, the majority of which are overcome in the laboratory prior to shipment of the equipment for regular theatre use. We shall, therefore, discuss only those troubles which may properly be classified as "field troubles." Easily the most common trouble with sound heads is that which is variously known as "warble," "wow-wowing," and pitch changing. The cause of most sound head troubles is variation of speed, and there remains only to correct the cause of this variation to insure maximum efficiency.

The period of the "wow" is the best clue to its cause. If a projector has the proper motor equipment, and "wows" are present, one may assume that some portion of the gearing is binding. Any gear or group of gears which complete one revolution to one change of pitch may properly be held suspect. If the sound head is driven from the projector itself, the chances are that blacklash in the projector gearing is causing the trouble, due to a "high spot" in the intermittent movement. The writer has experienced considerable trouble with the G-12's also. A bent or warped "A" frame will give much trouble until it is corrected by a new replacement. Turn the entire assembly over by hand and locate any spot that seems to drag by means of removing various connecting gears and shafts until the "high spot" is found.

Flywheel Considerations

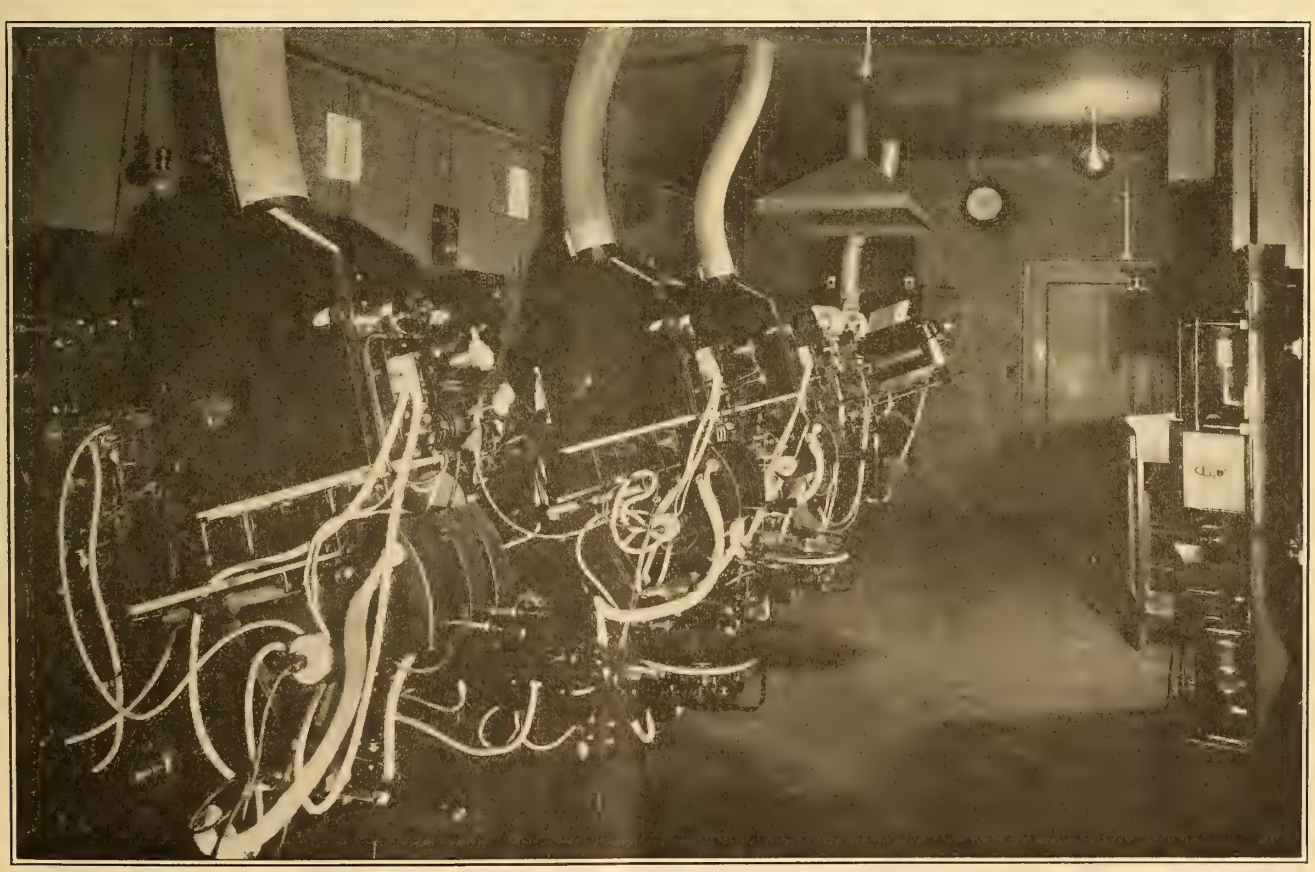
In cases where trouble is being experienced with single-phase and direct current power, the installation of a heavier flywheel will materially aid in overcoming the difficulty; but be positive above all things that there is no one point in the entire gear train that is binding. Better results are invariably obtained from systems in which the sound head is driven from the motor and the projector head driven by some type of drive from the sound head, than when power is supplied the sound head from the projector. This is the result of the inability of anyone to remove all backlash from the projector head gearing, which condition is aggravated by the variation of load on the intermittent movement.

Care in Oiling

Oiling should be handled in such a manner that no oil can reach the optical system, and while keeping oil entirely off the film is to be desired but can hardly be done, at least make sure that the very minimum reaches the film. All moving parts should have oil in sufficient quantity to insure protection. Wipe off all excess or spilled oil.

Electrical Troubles in Heads

1. *No Sound.*—Set up the fader and such switching equipment as may be required to pass the supposed generated sound of the projector on which we are working. Pass a card rapidly in the sound gate to interrupt the beam of light. A click should be heard each time that the light beam is covered or uncovered. If the click



Loew's Valencia Theatre, Jamaica, L. I., projection room. Plans by M. D. O'Brien

is not heard in the monitor horn, try tapping the first stage tube in the film amplifier. If still no sound is heard try the second, and if there is a third tube, try that. If the filaments are lit, there is a possibility that the "B" battery circuit is open, and this source of energy should be checked to the amplifier. Some film amplifiers have the filaments in series and if one of the filaments burns out, all of the tubes will have apparently failed. Try changing one tube at a time with one that you know is all right until you have located the defective one.

Never touch the inside of an amplifier until you have proved that the trouble is located there. Trouble will rarely occur in an amplifier, and is usually external, such as batteries, loose switch contacts, blown fuses, or other outside causes. A complete discussion of amplifier troubles and their location and clearance will be given in subsequent installments.

If the tests you have just made indicate that the amplifier is functioning correctly, and no sound comes through the system from the photo-electric cell, it is logical to assume that the trouble lies somewhere between the optical system and the grid of the first tube of the film amplifier. Touch the cathode pole of the photo electric cell with your finger. This is the lead that is attached to the ring inside the photo electric cell that is visible through the window of the cell. The method of bringing this lead out of the cell varies considerably with the make. Some leads come out through a regular vacuum tube base, while others are brought through the glass at the apex of the tube. Touching this lead should give a resounding bang in the monitor speaker. If it fails to respond, it indicates that there is trouble either in the coupling between the photo electric cell and the first tube of the film amplifier, or that the battery supply to the cell has failed.

Voltmeter Testing

A voltmeter test at this point of the circuit (cathode of photo electric cell), will disclose nothing due to the heavy drop in voltage at the grid leak located in the coupling circuit to the grid of the first tube of the film amplifier. Make your test with the voltmeter at the battery side of the resistor and a true voltage reading will be obtained. If the voltage is correct or within the required limits prescribed by the manufacturer of the cell, and the amplifier is working (as proved by tapping the first tube), then the trouble can only be in the cell itself or in its closely associated equipment, such as the socket and connecting leads to the amplifier, or the condenser separating the voltage to the photo electric cell from the grid of the first tube. A careful inspection will disclose the trouble.

Other Troubles

Loss of volume, sudden or gradual; hum, "motor-boating," phonetics, oscillation, crackling.

A sudden loss of volume is indicative of some violent change in the working conditions of the unit, and this is usually due to a piece of wax or dirt of some type entering the slit and preventing the light from scanning the film; or, possibly, the film riding out of focus due to the gate opening or not having been closed at the start of the reel.

A loss of volume over a period of time is usually due to battery deterioration, lens system becoming dirty, or the lamp becoming blackened and the filament sagging out of focus. Tubes in the film amplifier usually give about a thousand hours before the filament shows signs of poor emission.

Hum may be caused by an outside source of electrical pick-up, such as dimmer banks (if in projection room), motor grounds, grounds in the motor feeds of arc lamps and such other sources. If believed to be from any of these, open both wires at the power panel of the various units until the trouble clears. This will show you the offending circuit and the cause for the interference can be readily ascertained. Another source of hum is that of the film failing to run past the light beam in it's proper path. When the light runs through either the sprocket holes or into the picture portion of the film a hum of about sixty-cycle frequency will be heard. A hum will sometimes be produced when some portion of the photo electric cell or film amplifier is touching the metal part of the housing. This is due to the vibration of the projector being transmitted into the cell to the tube elements, and can be cleared by preventing the part from touching the case, using tube packing. It is well to run the projector occasionally without film to check up on this item.

"Motor-Boating"

"Motor-boating" is caused by the breaking down of the photo electric cell, due to excessive battery potential or air leaking into the cell. Replace any cell that "motor-boats." The name is derived from the similarity of the sound to that of the "putt, putt" of a motor boat, and when once heard is easily recognized. A cell will sometimes break down completely and a pink to a violet light will be apparent in the cell window. A squeal may or may not accompany this condition.

Phonetics are caused by virtually the same thing that happens when you tap the outside of a vacuum tube. The elements within the tube are set in motion and due to the relative change in their position cause electrical changes in the circuit that are amplified in the following stages until the effect becomes objectionable. Make sure that no portion of the cell is touching the sound head and that it is well-cushioned. Do the same with the film amplifier. It is well to try various tubes in the first stage to find one that will give the least trouble in this respect. Try to remove as much vibration as possible from the projector to further dampen this effect.

Oscillation in properly designed equipment is merely a bad case of

(*Continued on page* 43)

Projection Schools

(I. A. General Bulletin, No. 245, Dec. 2)

THE attention of the General Office has been called to several recently organized projection sound schools, offering a correspondence course in sound projection. For a great number of years our International Alliance has spent considerable time and money in discouraging operators' schools of all descriptions. Such schools invariably make it a practice of attempting to interest their prospective victims by promising them jobs at operating at an attractive salary.

It should be unnecessary to call a matter of this kind to the attention of the general membership of our organization but strange as it may seem, a number of our members have paid money, earned as members of the union, to such projection schools. The result is that money earned under union conditions is being utilized to train non-union men, who, after all, are certainly a menace to our organization.

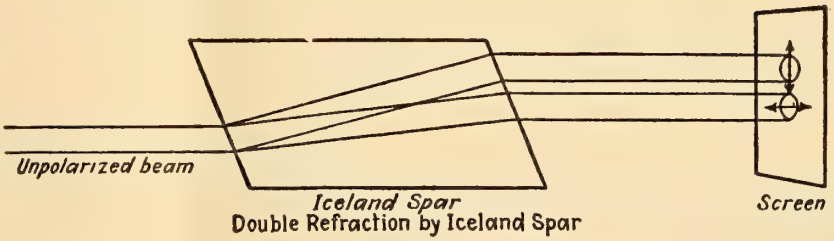
If the membership of the various operators' organizations desire to carry on a course of instruction in projection they should organize a local study class for this purpose. Technical information dealing with all phases of projection can be had. After all, this is the sensible and practical way of doing it. Several of the so-called "Projection Schools," offering to train men, upon investigation have been found to have a faculty composed of men who had never worked a single day as motion picture machine operators. It is easy to understand that men of this calibre are not competent or qualified to train motion picture machine operators.

In the future it would be advisable for all members of our organization to refuse to give any consideration to any correspondence course, unless such course had first been approved by the International President. It is to be hoped that it will not be necessary to again call this matter to the attention of the membership of our organization.

Elementary Optics

By SAMUEL BAGNO

THERE have been two theories regarding the nature of light. Newton thought that light consisted of tiny corpuscles that were emitted from a luminous body. On the basis of this assumption he tried to explain all the phenomena pertaining to the transmission of light. One thing puzzled him, however, and that was what is now known as *polarization*. Previous investigators had discovered that a beam of light traveling through Iceland spar (Fig. 1), was refracted in two ways at the same time, so that instead of one beam of light leaving the Iceland spar, there were two separate and distinct beams, each traveling in a different direction (Fig. 1).



Double Refraction by Iceland Spar

Figure 1

Newton had previously accounted for refraction by stating that the particles of light traveling close to the atoms of the refracting material were bent out of their path by the attraction of gravity to the atoms. Because the molecules were all of a single weight, it was natural to expect, on the basis of this theory, that the light entering a heavier medium would speed up, because of the added attraction of the molecules.

Later experiments proved this to be untrue. In fact, they showed that the index of refraction of any transparent object was the ratio of the speed in air to the speed of light in that object. This meant that light actually slowed down in traveling through a denser medium. These discrepancies led Hygens to bring forth the wave theory of light.

Light Wave Lengths

Light consists of a form of wave energy. These waves are electrical in nature and, except for wave length, are identically the same as radio waves. A comparison will show the differences. A wave length of light is in the neighborhood of one one-millionth of an inch; whereas a radio wave has a wave length of several yards. Color depends entirely in the wave length of light striking the eye, red giving the longest wave length and violet the shortest. The other colors follow in order of wave length exactly as in the spectrum.

Since electrical vibrations consist of the vibration of free electrons in space, they are free to vibrate in two directions. Some of these electrons are polarized, or vibrate, in a direction perpendicular to the rays of light; while other electrons are forced to vibrate at right angles to the direction of the ray of light.

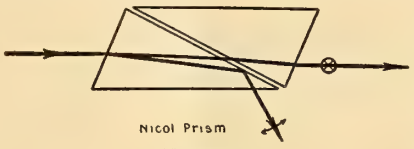


Figure 2

This action is known as *polarization* and presents some interesting phenomena.

There are several ways of selecting light polarized in one direction and not in the other. A piece of Iceland spar can be used as a filter very effectively and has been incorporated into what is known as a nicol prism (Fig. 2), which allows one ray of light to go through it, and reflects the ray polarized in the opposite direction.

Tourmaline Crystals

A crystal of tourmaline has the property of polarizing light completely, so that two crystals of tourmaline can be made to pass all of the light or cut it off completely. A mechanical analogy to this action of tourmaline is presented in Figure 3. The zigzag lines represent the waves. Two rays at right angles to each other pass into the first crystal of tourmaline, which is shown by an analogy (two parallel bars). On leaving this piece of tourmaline there is only one ray which vibrates only in a vertical direction. This ray passes into the second crystal, and when this crystal is facing in the right direction (as shown in the first part of the figure), the ray encounters no difficulty in passing through.

However, if the second crystal is at right angles to the first (as shown in the second part of the figure), no light can come through. Tourmaline is a perfect polarizer, but due to the poor color of the crystal—a dull brown—it is very seldom used for this purpose.

When light is polarized by one nicol prism and strikes another at right angles to it, no light can penetrate the second prism. If, however, the other prism is rotated, some light can penetrate. More and more light penetrates the second prism as it is rotated, until the two prisms face the same direction, at which time the maximum amount of light can travel through it.

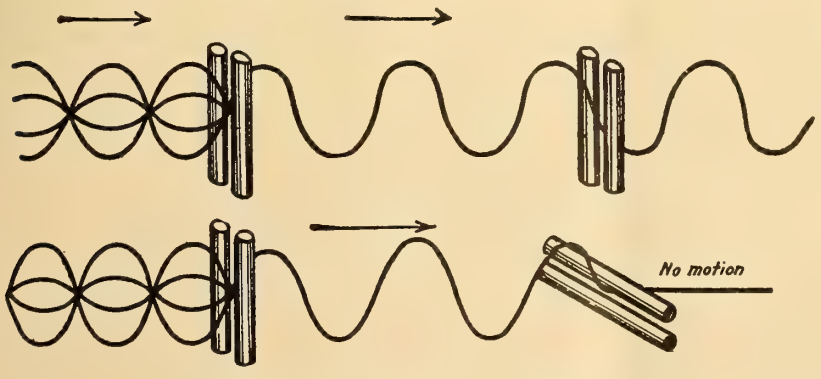


Fig. 3—Mechanical analogy to tourmaline

Angles of Polarization

All refracting substances have the power of twisting the direction of polarization, depending on the wave length of the light and the refractive index of the prism. It is due to this twisting of the rays of light that when a refracting substance, such as a piece of glass, is placed between two nicol prisms, all weird color effects may be obtained with only a source of white light.

When, however, the light of a single color is transmitted through the prisms, and a piece of glass is put between them, the light is found to have a different angle of polarization. This angle of polarization can be altered by the slightest mechanical pressure on the glass. A strong magnetic field will also alter the angle of polarization of the light. Such schemes have been used by many an ingenious inventor as a

means of recording light on a moving film.

Perhaps one of the most ingenious uses of polarized light was that of measuring the thickness of a potassium film on the glass of a photo electric cell. It was found that the thin film has the property of rotating the angle of polarization. Making use of this property, the mathematical law of which could be very easily deduced, engineers at the Bell Telephone Laboratories succeeded in measuring a potassium film one forty-millionth of an inch thick.

(To be Continued)

Single or Double Reels?

MANY comments were received on the article "Why 1,000-Foot Reels?" which was contributed to the December issue by Secretary F. P. Broadbent of Local Union 360, Edmonton, Alb., Canada, the most interesting of which are reprinted below. Obviously there is a sharp difference of opinion on this highly important phase of sound film reproduction, and the following letters suggest that additional comment from readers might prove beneficial in establishing the consensus of opinion on this point. To this view we heartily subscribe, and we shall anticipate further interesting comment on the subject between now and the next issue.—THE EDITOR.

Editor,
M. P. PROJECTIONIST.

Sir: After reading Brother Broadbent's letter in the December issue, we feel forced to comment and to refuse to go back to the old practice of using 2,000-foot reels. We agree with Brother Broadbent when he says that the continuous hooking-up and splitting of 2,000-foot reels ruins the continuity of the picture and that in many cases essential dialogue is lost.

We have recently received letters from both United Artists and Metro-Goldwyn-Mayer which set forth several definite reasons why pictures should not be hooked-up on 2,000-foot reels. Now, from the viewpoint of a projectionist, we wish to state our opposition to double reels.

5 Votes for Singles

1. In running double reels the exciting lamp is on twice as long, thereby being subjected to undue strain which weakens it. An exciting lamp should be allowed to cool after each single reel. 2. We object to being forced to stand alongside our projectors for a period of twenty minutes or longer, which is demanded by double-reel operation. 3. Some states, assuming that double reels will give rise to laxness on the part of the projectionist, have passed laws forbidding their use. 4. Most of our programs consist of part sound-on-film and part disc, and we imagine that it would be somewhat confusing to have part of the show on 1,000-foot reels and the other on 2,000-foot reels. 5. New York City Local 306 recently passed a ruling forbidding any projectionist in their jurisdiction to hook-up double reels for use in a theatre. In view of the fact that 306 is not only the largest Local Union but has also had sound equipment longer than any body in the country, we assume this action was based on long experience and with an eye to better projection.

We would suggest that the disc companies, instead of trying to make 2,000-foot reels for their subjects, continue the use of single reels and encourage the few companies who now favor the former to use only singles.

In closing may we say that we would like very much to see expressions in your publication from other readers.

Local Union 312, Enid, Okla.
GEORGE L. MCCANN,
Corr. Secty.
H. H. WILLIAMS,
Fin. Secty. & Treas.

Editor,
M. P. PROJECTIONIST.

Sir: The article in the December issue regarding the use of 1,000-foot by film producers is heartily endorsed by our Local Union members, and Brother Broadbent deserves a vote of thanks for bringing the subject up at this time. All the points enumerated by him—improved changeovers, retention of essential dialogue and general all around convenience—are true. It also requires less time in setting up and taking down a show.

I believe it would be a good idea to get the opinion of projectionists in every part of the country on this point, thus tending to correct the existing evils which spring from this injurious practice.

A. H. ESTES,
Secretary Local 347,
Columbia, S. C.

Editor,
M. P. PROJECTIONIST.

Sir:—Brother Broadbent's comment on "Why 1,000-Foot Reels?" in your December issue is indeed a timely topic, for I know of no one projection problem which is more pressing at present than that of uniform reel sizes. However, we out here in Iowa think Brother Broadbent quite in error, as our experience has been that none of the *leading* film producers have as yet adopted the practice of shipping their sound-on-film subjects on 2,000-foot reels.

I will admit that the practice of shipping this product on 1,000-foot reels has done much to mar the presentation of many sound pictures, but why blame it on the reels when the majority of the time the reason for mutilated prints is the projectionist who on a prior run has cut into these prints?

Personally I come across too many evidences of projectionist delinquency in this matter.

Brother Broadbent further states that nobody runs subjects, either silent or sound, on single reels; yet he would be surprised to learn that out this way there are hundreds of us who do that little thing. The fire hazard alone is enough argument in favor of the single reel:—two reels of film will make just that much more of a fire than a single reel.

A projector take-up with enough tension to take-up a 2,000-foot reel would in all cases cause too much tension on the first 100 feet or so of film, particularly in the older projector models. Then there is the matter of the exciting lamp filament. I understand that running 2,000 feet of film demands that the exciting lamp be lighted for too long a period, whereas the single reels allow it a chance to cool after a short period and adds materially to the life of the lamp.

Most of the leading film producers in this territory send out letters with each and every print requesting us not to double up their sound-on-film prints and state that if the same is done we will be charged accordingly.

In closing I will say that if a uniform reel standard could be agreed upon throughout the industry, there would be so few bad changeovers due to mutilated prints as to be negligible.

H. T. COLEMAN,
Secrteary, Local 567,
Boone, Iowa.

Novel Screen Experiment

It is well known that celluloid is highly inflammable, and not a suitable material for use on a stage. The Beaded Screen Corp. has perfected a noninflammable material used in making the Vocalite Sound Screen. Experiments show that Vocalite Sound Screen can be made fireproof, without impairing its value as a reflecting medium or impairing its sound permeability. It is possible to treat this screen in the process of manufacture, so that it acquires substantially the properties of asbestos, and yet not lose any light power or sound value.

A test made of Vocalite Sound Screen, and a piece of perforated screen, disclosed the following state of affairs. The test pieces were four inches long and one inch wide, and were lighted at the same time. The perforated screen burned up in a roaring flame and was entirely destroyed in about thirty seconds. The Vocalite test piece burned very slowly and at the end of thirty seconds only three-quarters of an inch had been consumed. It took over three minutes to entirely destroy it.

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I remain,

Very truly yours,

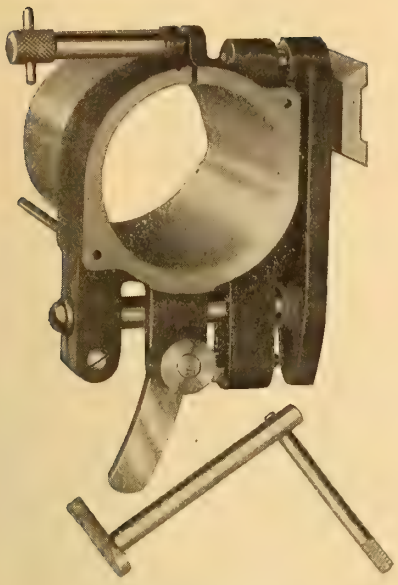
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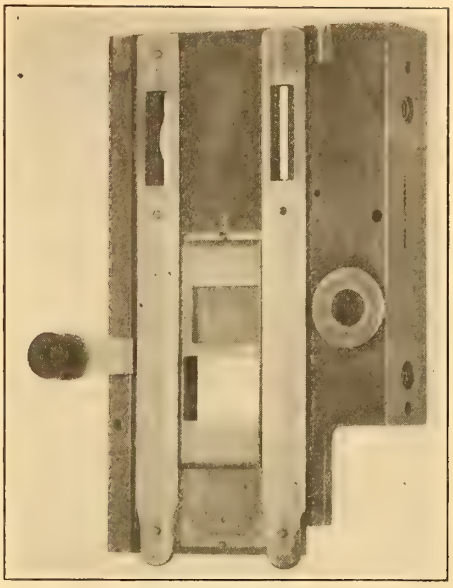
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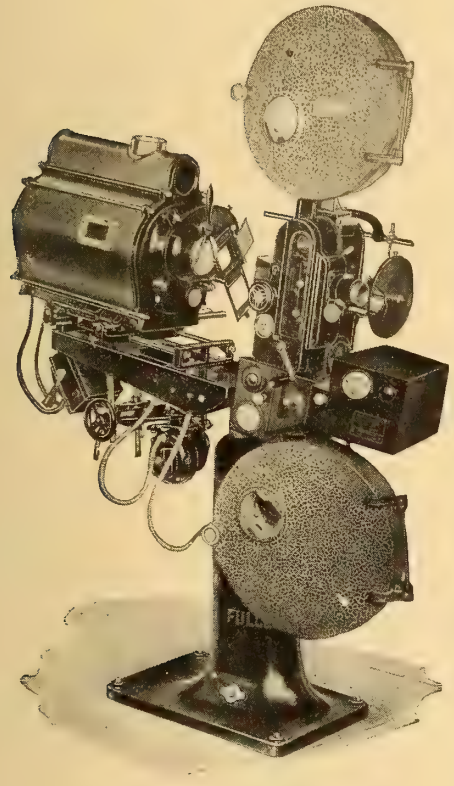
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Efficient Sound Projection

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

PROJECTIONISTS are wholly responsible for the quality of sound in their particular theatres. They are also responsible for the proper maintenance and operation of the sound equipment. There can be no alibis on the part of the projectionist for poor results with his equipment, providing, of course, that he is given the proper equipment to work with. It is his place to demand new equipment at such times as he feels a proper presentation requires it. While the major sound picture equipment companies maintain service engineers for the purpose of checking their equipments, this fact does not relieve the projectionist of responsibility for his apparatus.

Flutter in the Horns

I recently visited a theatre and noticed a very bad flutter, and upon investigating the reason for same I discovered that a small piece of lint had lodged in the sound aperture and was kept in motion in front of the light beam as the film moved through the compartment. This was the cause of a very serious flutter which utterly ruined a considerable portion of a dialogue film.

After cleaning the sound aperture and film compartment, it is best to carefully check everything to see that all dirt and lint has been removed.

P. E. Cell Amplifiers

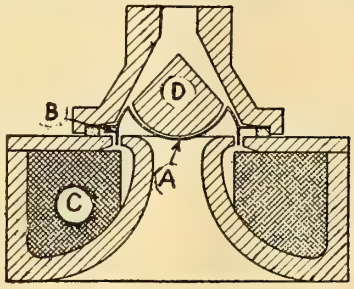
With the exception of a few spare parts, Western Electric does not furnish auxiliary equipment with its sound projector system. On many occasions I have been present in theatres which were encountering serious trouble with one of the photo electric cell amplifiers, The following temporary connection was made so that a continuous performance could be presented with film reproduction:—

Assuming that No. 1 projector photo electric cell amplifier is totally disabled, and one is compelled to run the remainder of a show on No. 2 projector, No. 1 projector may be used for the balance of the show by providing two leads long enough to reach from No. 1 projector photo electric cell to No. 2 cell. Connect the two leads to No. 1 projector p.e. cell positive and negative leads, and then connect the other end of the leads to No. 2 projector p.e. cell terminals.

Make sure that the positive and negative leads of both photo electric cell leads are the same before proceeding to resume operation.

No. 2 projector photo electric cell amplifier is now taking care of both cells. On making changeovers, bring the fader to zero in the usual manner, but do not fail to keep in mind that you are using *only one-half of the fader for the p.e. cell amplifier*, which is in operation.

Good work cannot be done with a soldering iron that is not kept clean and well tinned. A small wire brush

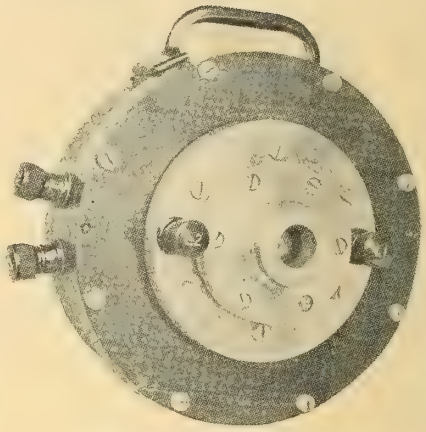


Sectional view of 555-W receiver. A, diaphragm; B, actuating coil; C, field coil; D, tone chamber

is useful for cleaning the tip of the iron before tinning. A woolen cloth or asbestos pad should be used to keep the point clean.

555-W Receiver

The 555-W Western Electric receiver marks a distinct forward step in loudspeaker construction, especially from the viewpoint of efficiency and volume of sound produced. The



555-W Receiver (W.E.)

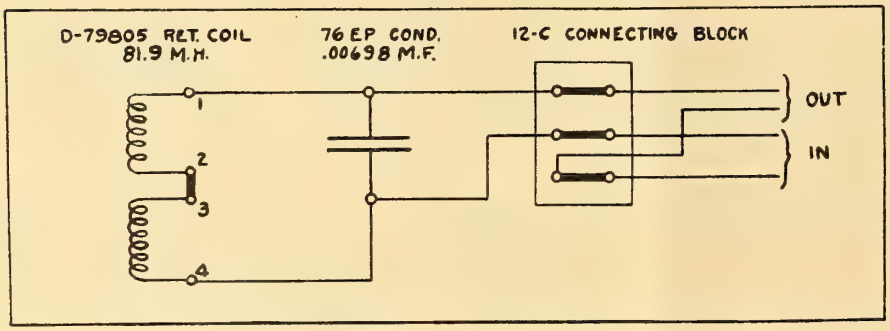
diaphragm, "A" in the accompanying figure, is made of thin aluminum alloy and the central portion is cupped into portions of two spherical surfaces. This diaphragm flexes only near its outer edge and gives considerably better results than the flat type of diaphragm that flexes throughout. Driving is by means of a single layer coil "B," of edgewise-wound aluminum ribbon, attached to the diaphragm and reacting with the field winding "C". This driving coil has high-carrying capacity due to its single layer construction, small amount of pulsating material, and consequent high rate of heat dissipation.

The cone-shaped piece, "D," is located in front of the diaphragm to shape the tone chamber for proper distribution of the air pressure waves, and this, with the plunge-like motion of the diaphragm, largely contributes to the high efficiency of the receiver.

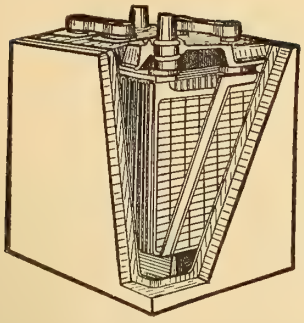
Storage Batteries

IT is very essential that storage batteries receive the best of care and attention at all times. The matter of battery replacements has become one of the major problems of projection room work. With sound picture equipments the "A" type storage batteries are used to light the filaments of the amplifier tubes, to supply magnetizing current to the receivers attached to the horns, and also to supply the current for the reproducer or exciting lamp filament.

The "A" battery has a terminal voltage of 6 volts, and each battery has three cells of 2 volts each. Each cell is made up of several positive plates and several negative plates. All positive plates are connected together, and all negative plates are similarly connected. The positive and negative plates alternate with each



D-85128 Equalizer for 555-W Receiver



Storage battery with cells in series.

other in position and are kept apart by separators of wood, celluloid, or hard rubber.

The plates themselves are made of lead alloys and chemical compounds of lead. The plates and their separators are immersed in a bath of sulphuric acid diluted with water—this liquid being known as the *electrolyte*. The electrolyte and plates are carried in a jar made of glass, hard rubber or other insulating material.

Electrolyte Action

When the battery is fully charged and in good condition, the positive plates have a dark reddish-brown or chocolate color; while the negative plates are gray or slate colored. When the batteries are connected to the amplifier and the filament switch is turned on, an action immediately begins to take place between the plates and the electrolyte. A part of the sulphuric acid in the liquid combines with the lead in the plates to form lead sulphate, and the surfaces of both plates gradually become covered with this sulphate.

Plate Surface Change

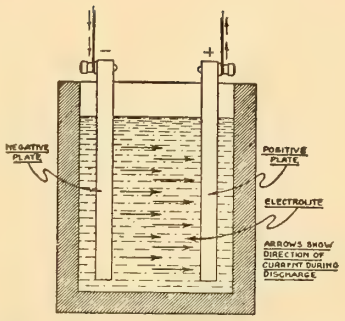
The percentage of water in the electrolyte is increased because of the combining of part of the acid with the lead of the plates, leaving water in the electrolyte. The surfaces of the plates thus change slowly to lead sulphate, while the liquid becomes more nearly pure water. When the battery is recharged, the sulphate of the plates combines with part of the hydrogen and oxygen in the electrolyte to form more sulphuric acid. The positive plates then become peroxide of lead and the negative is left as sponge lead. This transformation continues until the sulphate is completely reduced, and the battery is then said to be charged.

Battery Connections

I have found during my many visits to different theatres that battery connections are being neglected. It is imperative that battery straps be removed and both strap and lug be cleaned. Apply a little vaseline and replace, and be positively sure that the connection is tight. Poor battery connections have been the cause of noisy reproduction in many theatres.

If the polarity is not marked on the battery terminals, it may be determined in the following manner:

1. Cut a potato in half and insert the two leads from the battery: a green formation will take place around the positive terminal.
2. A direct current voltmeter will read correctly only if connected positive to positive, and negative to negative. Get a reading on the voltmeter and note the marking on the connecting posts.
3. Dip the terminals of the battery into a glass of water into which a little salt has been dropped, being careful not to let the terminals contact:—bubbles will appear at the negative terminal.
4. Use a polarity indicator. This may be purchased at any electrical supply store.



When a battery discharges, the current flows outside the battery, thru the circuit, from the positive terminal to the negative terminal. The flow inside the battery is from the negative to the positive, thru the electrolyte, as indicated by the arrows.

Changing P. E. Cells

When photo electric cells are changed, be sure than the window of the new cell is properly lined up with the opening in the compartment, separating the cell compartment from the film compartment, otherwise the reproduced sound will be distorted. When flutter occurs, check the film compartment first.

New Precision Pick-Up

Announcement has been made of a new precision electrical pick-up which, it is claimed, has a uniform frequency response of from 40 to 6,000 cycles, or sufficient range for the faithful reproduction of recorded music. The pick-up is said to have successfully withstood a 10-hour life test on the vibrometer, or scientific yardstick of electrical pick-up life, as contrasted with an hour for the ordinary pick-up. The electrical resistance is 49 ohms, which is unusually low.

The pick-up head is mounted on an arm which rides on a ball-bearing swivel and carries a sliding weight so as to adjust the stylus bearing pressure for best results with any type record. Developed by General Electric for the Radio Receptor Corp., N. Y. City.



D-86849—Non-synchronous double turntable with record cabinet. Also showing model arrangement of such equipment.

As The EDITOR *Sees* IT

¶ *Wholly A. C. Apparatus*

FREQUENT reference in this section of the necessity for developing a sound picture apparatus which would be operated throughout by A. C. has evidently borne fruit, according to the announcement made recently by Rudolph Miehling, well-known in the projection field for many contributions to the art, that he has succeeded in developing such an apparatus which, while marking a distinct forward step in the sound picture engineering field, sacrifices not one whit in operating efficiency to the exigencies of such a development. Elsewhere in this issue there appears what little data is at present available on the Miehling development, patent considerations having precluded the possibility of presenting specific facts on the equipment just now. While we have no hesitation in stating that Miehling's equipment is not only practicable but highly efficient, we shall look forward with interest to the release of details of the system and shall hope that here at last is the thing to which many of us have looked forward with enthusiasm.

Theoretically, storage batteries have been the answer to one of the most serious problems of sound picture reproduction; but simply because of this fact it shouldn't be necessary for us to plod along contending with the many difficult features of such equipment when a satisfactory apparatus which dispenses with the need for batteries hoves into view. Personally we could never see very clearly why no assault was ever made on the forces of those who could see nothing else but battery supply. Expense in great quantities and inconvenience in only a slightly lesser degree have been the general experience with batteries. And the first reason is easily the most important of the two.

¶ *Obituary*

AN official statement on "projection schools" was issued recently by President William F. Canavan of the International Alliance and printed in the last issue of the General Bulletin, a copy of which also appears elsewhere in these pages. This statement by President Canavan should be read carefully by every member of the Alliance as indicative of the attitude of their elected officials to all propositions of this sort. Such ventures into the realm of "education" are for the most part purely and simply promotional schemes; and in practically every case the promoter is one who has seldom, if ever, had practical experience on a regular projection room shift.

As we remember the prospectus of one of these institutions of learning, as outlined to us by the promoter in person, the plan was to assemble a few thousand "nuts" who would be lured by promises of big salaries within a short time to put their names on the dotted line and come across with the enrollment fee. Projectionist members of the Alliance were listed as constituting a healthy majority of the student body and would thus be placed in the position of paying over money earned as union men for the privilege of supporting an institution which in turn would make no bones about instructing other men to supplant its own students.

It may not be generally appreciated by the rank and file of the Alliance membership that this situation constituted a real menace to the well-being of the organization, and the Alliance officers are to be congratulated for their prompt and efficient action in moving to squelch the furtherance of such unbalanced schemes.

¶ *A Peek Into* 1930

AS we approach the turn of the year we may well look back and reflect that the old year, now that it is nearly gone by, was not so bad after all. Surely the majority of us have been rather kindly treated, and the general prosperity existent in the motion picture industry has been participated in by projectionists as well as other workers in the field. Latest estimates place the funds invested in the industry at $200,000,000, and it is inevitable that this figure will take a substantial swing upward in another twelve months. Many new things are planned for the coming year, and we feel certain that projectionists will continue to play a responsible part in their development.

Wide film, color, and third-dimension pictures are a few of the things which the future holds in store for us. Colored film has made amazing progress within the past year, and the application of new principles recently developed in this art will be reflected, we think, in an almost universal use of color within a short time. Wide film has made a brief bow, and we liked it; the next few months will tell the story as to the permanence of this development. Third-dimension pictures are still in the offing, yet the introduction of wide film may be regarded as a promise that the industry will not have long to wait before stereoscopic pictures will be available.

Speaking strictly from a projection angle, it is our opinion that, after the brilliant minds of the production forces have invented every conceivable thing to enhance the value of the picture, they might well turn their fine talents to the matter of reproduction, particularly with regard to the problems of the projectionist. Not that we feel the projectionist really needs this assistance but simply because we feel that if this storm of new equipment doesn't subside, it will soon be the common thing to have the projectionist take up his quarters permanently in his projection room, and all because of his inability to find his way out among the maze of equipment.



Greetings for 1930

from the

International President

ANOTHER year has passed, a year marked by continued progress in the motion picture industry in its many branches of endeavor. Twelve months ago there were many problems demanding the attention of the best minds of the industry; and while it may not be rightly said that all these problems have been solved, it can be said that much splendid work has been done which has contributed largely to a more stabilized condition.

In no branch of the industry has there been more progress within the past year than in the reproduction of motion pictures with sound in the theatres. The improvement in reproduction technique has been noteworthy, and motion picture exhibitors need have no concern about proper presentation of programs in their theatres. The individual theatre was the proving ground for sound pictures, the success of which may be attributed in large degree to the intelligent manner in which they were handled by the projection staffs of all theatres—large and small—throughout the United States and Canada.

No small part of the credit for the steady forward march of sound pictures is due the projectionist craft, whose members by their alertness, ability, loyalty to their employers, and never-waning desire to attain perfection in their profession, have placed their craft in the very forefront of labor craftsmen.

It seems to me particularly appropriate at this season of the year to compliment the projectionist craft on their splendid work during the past year—work which augurs well for the future—and to commend the officers of the various Local Unions for their able direction and maintenance of a splendid morale.

The officers of the I. A. T. S. E. & M. P. M. O. U. join with me at this time in extending to the membership of the Alliance their wishes for A Happy and Prosperous New Year.

WILLIAM F. CANAVAN

in the Laboratory

Conducted by SAMUEL WEIN

16 mm. Sound Recording

AT present there are three designs for equipment to be used for showing sound pictures in the home. Several features of this equipment are of more than passing interest to the professional motion picture worker. The three designs are: (1) mechanical synchronization between a phonograph record and the film, (2) the use of a "home" projector using a 35 mm. film, and (3) the use of a 16 mm. projector. By "home talkie" is meant a machine not particularly adaptable for professional use in theatre projection work but which is used for home entertainment, schools, and advertising purposes.

There are three means of synchronizing the film with the record, and these are (1) mechanically, as by means of a train of gears coupling the phonograph to the projector, (2) the use of sprocket holes in the film to drive the disc, and (3) by the use of synchronous motors, as in professional work.

Space and Speed Problems

The recording of sound on 35 mm. film for home talkies presents no problems that have not already been solved in the commercial forms of sound recording. However, the 16 mm. film presents an entirely new set of physical problems, principally the questions of economy of space and the difference in relative speed between 16 mm. and 35 mm. film. It is well to remember that 35 mm. film runs at about three times the relative speed of 16 mm. film. Another important consideration is the fact that the silver grain of the 16 mm. film has an approximate diameter of 1/400 of an inch.

Reducing the above facts to simple arithmetic, we find that 16 mm. film travels at the rate of approximately 6 inches per second, and because of the comparatively large grain of the silver particles, the highest frequency possible to record on the present commercial type of 16 mm. film is 2,400 cycles per second. This permits understandable speech reproduction but musical reproduction is subject to severe distortion.

Another difficulty in 16 mm. sound recording is that of the slit. For this purpose it has been found necessary to reduce the diameter of the slit used to one-third the professional standard size. Those who are familiar with this phase of the art will, I believe, agree that the accomplishment of this feat is nothing short of a miracle.

New Eastman Grain

Other engineering difficulties in connection with this field are certain to be solved within a reasonable period of time. The problem of frequency has been attacked from various angles, and a sufficient number of pictures per second have been recorded on the film to increase the reproduction speed to very nearly 90 feet per minute. This method is not very efficient, however, and it would seem that the best possible solution lies in using a much smaller grain or using a different type of photographic medium altogether. We are advised that Eastman Kodak Co. has succeeded in producing a much finer grained silver emulsion which will undoubtedly contribute largely to the solution of the problem of grain.

The sound slit problem may be nicely solved by using an optical projector in which the film would run continuously instead of intermittently. The problem of space may be solved by having sprocket holes on only one side of the film, or between the pictures, as is now done in the Patnex system.

Optical Slits

We have recently had occasion to examine the claims of C. Francis Jenkins, of television fame, on the use of "optical slits." The patent referred to is 1,390,445 of September 13, 1921.

The optical slit described therein by Jenkins is seen in the accompanying illustration. It will be seen that an incandescent lamp *A* is in the focal point of a reflector *E*. This source of light is now focussed through the medium of a lens *J* and through a diaphragm or course slot *C*. The source of light is now further reduced to a fine slit by means of a lens *D*. This light is now focussed through the sound track on the film and onto the photo electric or other form of light sensitive cell.

Jenkins Patent Range

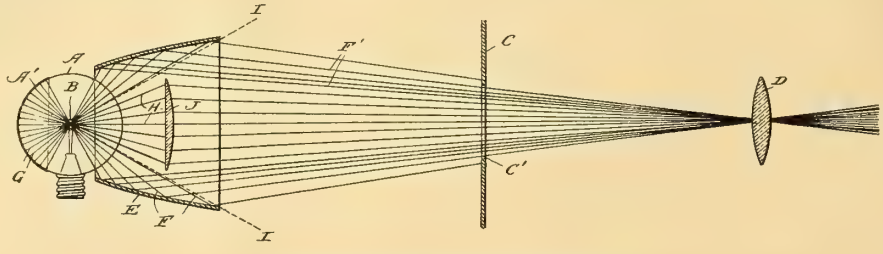
In discussing this optical slit patent with a number of persons in authority we found them in entire agreement with us in that this Jenkins invention is identical in every respect with the optical slits now so commonly used in the sound head of sound picture apparatus.

We are advised by officials of the Jenkins Television Corp. that they have no intentions at the present time of entering the sound picture field, although it is apparent that they have enough "patent background" to warrant their doing so. The many patents held by Jenkins cover almost every phase of the motion picture industry, including the photographic, projection, sound picture and television ends.

Complete A. C. Apparatus Developed by Miehling

AN interesting experiment in straight A.C. sound picture apparatus operation is now in progress in the laboratory of Rudolph Miehling, sound editor of THE MOTION PICTURE PROJECTIONIST. Miehling has long subscribed to the view that A.C. operation of sound picture apparatus was not only feasible but desirable, from both the economic and operating efficiency viewpoints. The desire to rid the projection room of storage batteries, a point on which much information has appeared in these columns, led Miehling to compile all available data on the matter and proceed to work out the problem in his laboratory.

Certain patent considerations forbid complete disclosure of the Miehling apparatus, particularly with regard to circuit arrangement. Full information on all these points will be published in these columns as soon as practicable. Meanwhile the following



C. Francis Jenkins Optical Slit Patent

points of interest with regard to this new A.C. apparatus may be presented:

Use Photo Voltaic Cell

Raw A.C. current is fed to the filaments of all amplifier tubes. The circuit used is of new and novel design and may be so utilized that the output of the cell may be fed directly into two 250's arranged in push-pull so as to get full theatre volume. Incidentally, a photo voltaic (liquid) cell is used in this apparatus instead of the usual photo electric unit. Full data on this new cell has been given in these pages.

Both the exciting lamp rectifier and the "B" battery eliminator are of special design and use special gas-filled rectifying tubes. One type of tube is used for the exciting lamp and another for the "B" eliminator, the combination producing excellent results in eliminating any A.C. hum in the system. Current for the horns is obtained from the use of a dry plate-type rectifier, and no appreciable hum is apparent from the speaker units.

Particular interest attaches to the use of the photo voltaic cell, which is radically different from any similar unit now used in sound picture apparatus, and for which a special circuit was designed by Miehling.

Color Cinematography

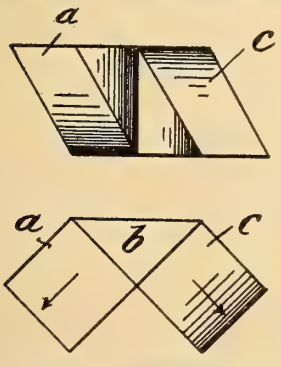
Recently we presented in this department a general outline of a new and novel system for color cinematography, on which a patent has been granted to K. Martin under U. S. Patent No. 1,728,426, Sept. 17, 1929. We are happy to be able to present at this time specific data on this interesting process which has been gleaned from the patent just granted.

Figs. 1 and 2 show a prismatic arrangement in which one is provided for each complementary color picture. It comprises three rectangular prisms, *a*, *b*, *c*, and each of the two faces of prism *b* is cemented to one face of each of the other two prisms. The two systems are so disposed that the exposed faces of the prism *c* are apportioned, respectively, to the two complementary picture d^0, d' of the film *d* in a frame of standard size, and the exposed faces of the prisms *c* face the objectives *e*.

It will be apparent that with one of the prism systems held in the manner shown in Fig. 2, an arrow placed as shown behind the prisms *c* would be viewed from the front, through the prism *a*, in the manner shown. The image would, of course, be rotated through 90°, as a requisite for the purposes of the invention as already explained.

In Fig. 3 a source of light is indicated at *f*, with a condenser *g* in the path of the beam; a cylindrical dispensing lens *h*, as shown, or a special condenser system may also be used.

If only two color partial pictures



Top, Fig. 1; Bottom, Fig. 2

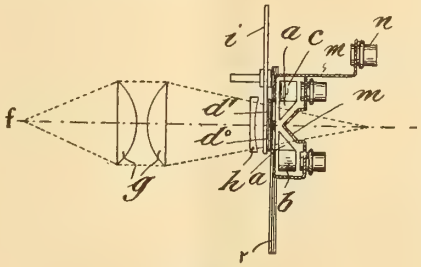


Figure 3

are to be used, the successive partial pictures d^0, d' will be taken and projected through red and green filters for example. On the other hand, if four complementary colors are to be used each pair of complementary partial pictures, for example red and green will be followed by a different pair of complementary partial pictures, for example blue and yellow. This arrangement is symbolically indicated in Fig. 5 in which d^0 indicates a partial picture taken through a red filter, d' a partial picture taken through a green filter, d^2 through a yellow filter and d^3 through a blue filter.

In order to uniformly screen the two complementary pictures during the feed of the film a single shutter *i* of the usual type may be used, covering both pictures.

It will be understood that an ordinary projecting apparatus, for black and white work, can be adapted for this purpose, by removing the objective, and perhaps also the condenser system or part of it, and substituting the double objective and prism systems which is described. To change

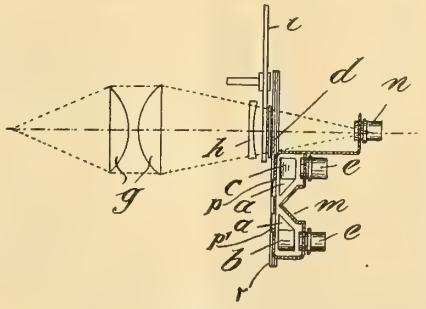


Figure 4

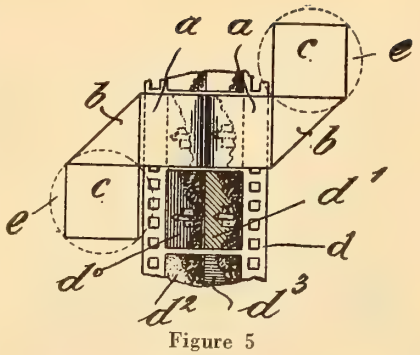


Figure 5

back to black and white work is equally simple. The color filters *p*, *p'* may with advantage be fixed to the objective holder, *m* on which are mounted the color objectives *e*, *e*, and the objective *n* for black and white projection, and the change-over can then be made very quickly and easily, particularly if the parts are arranged to slide into and out of position as on the slide *r*. This is mentioned because it may sometimes be desired to show black-and-white and colored pictures alternately, and films for the former and latter respectively may even be joined together, in one reel.

Recording with the Mercury Arc Lamp

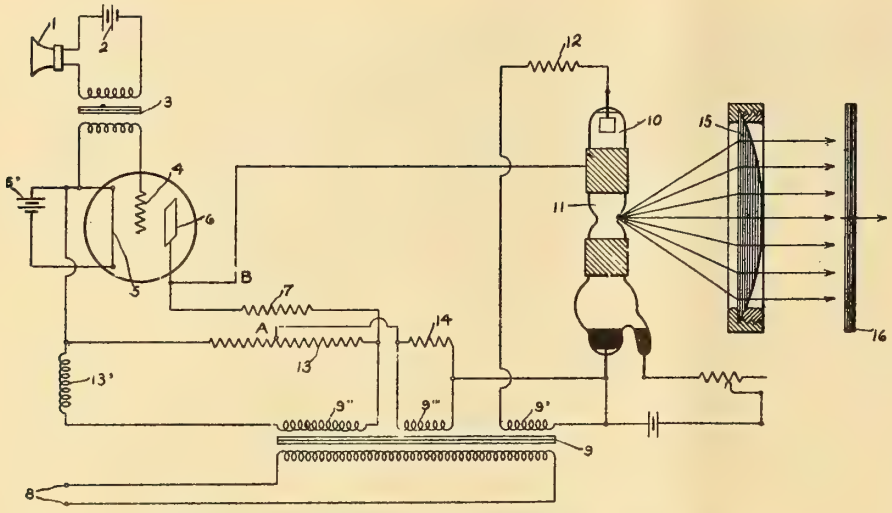
AT present there are two methods used in commercial recording of sound-on-film, and these are (1) the use of a string galvanometer, such as is used in the RCA Photophone method (saw-tooth), and (2) the use of a gas-filled tube. The first of these methods is very costly, and it is exceedingly difficult to maintain the efficiency of the equipment. The extremely fine wire is often broken by mechanical shock or by a too strong magnetic pull. The use of gas-filled tube is, on the other hand, much cheaper insofar as original cost is concerned, but these tubes also have their limitations in that their life in the recording equipment varies from five minutes to several hours.

This short-life period is a result of the deposition of the metal film on the glass wall, making it difficult for light to pass through the metal film on the glass tube. Another undesirable feature of these tubes is that they generate very little actinic light, which means that the film is considerably underexposed, photographically speaking. To compensate for this latter defect a contrasty sound track print is made.

Rich in Actinic Light

It is known that the mercury arc lamp is extremely rich in actinic light and therefore should make an ideal means for recording. Several experimenters attempted to use the mercury arc as a light source for sound recording, but the results of all of these efforts were of no commercial value.

P. M. G. Toulon, an "old hand" with



Method of recording with the four-element mercury arc

the mercury arc shows in his U. S. Patent No. 1,654,951 of January 3, 1928, a method in which a four-element mercury arc may be used as a recording tube. From a careful examination of the circuit described in this patent, one can readily see that it ought to give ideal results.

In this circuit we see the A. C. source at 8 fed into the primary, 9, of a transformer; one of the secondary windings, 9', feeds the anode, 10, of the mercury vapor tube, 11, through the resistance, 12. A second secondary winding, 9'', supplies the potential for the plate of the electron tube, through the resistance, 13, and induction coil, 13'. The A.C. potential at 8 is rectified at the same time that it functions as a "plate potential."

A third secondary, 9''', feeds a resistance, 14, and affords a current the potential of which is opposed to that of the anode. The resistances 7 and 14 are connected in series and to the metal plate on the outside of the mercury vapor tube, 11, as well as to the plate of the amplifying tube.

The sound is picked up by the microphone, 1, and these are amplified by the radio tube, and these amplified potentials are impressed on the cathode of the mercury vapor tube.

Book Review

SPEECH and HEARING — By Harvey Fletcher, Ph.D. 331 pages, fully illustrated. 6 x 9 inches. Cloth binding. Published by D. Van Nostrand & Co., New York City. Price $3.50.

ALTHOUGH this book was originally intended for the well-trained engineer in the highly technical realm of sound, its phases are so many and its substance so widely comprehensive, that it cannot fail but be of interest to everyone who has anything to do with speech and hearing. Then, too, the very interesting style of the author makes the work more than a mere reference, more than a textbook.

While sound is one of the most common of all our faculties it surely is the least understood. It was only some fifteen years ago that Bell Telephone Laboratories undertook a comprehensive study of speech and hearing in order to get the fundamental facts on which to base the design of all their telephone instruments. They found the field almost void of any previous investigation; in fact, they had to devise their own measuring instruments.

Bell Telephone Laboratories is the outstanding technical research organization in the world, thus they were able to proceed with an investigation which practically made a complete science out of an almost unknown natural phenomenon. The results of these extensive researches are ably recorded in *Speech and Hearing* by the man who directed them, Dr. Harvey Fletcher.

The book is divided into four sections. The first part deals with speech and, among other things, shows the complete mechanism of speaking and concisely analyzes the different speech sounds, tells how they are produced, and explains what makes them understandable. The second section deals in similar fashion with music, telling us exactly what enables us to distinguish one musical instrument from another, and one musical sound from another, together with an explanation of pitch.

The third part is concerned with the mechanism of hearing and explains just how different sounds affect the ear and just how the message of a sound is transmitted to the brain. In the fourth section there is set forth at length the effects of various other sounds on the brain of the hearer.

Various types of deafness are classified, and the different tests for each type are stated. It is interesting to note that a person may have normal hearing for speech and yet, for all practical purposes, may be deaf to music.

Speech and Hearing is an absolute essential for the serious worker in the field of sound; but it is doubtful if, because of its highly technical style, it will have more than a limited appeal to others.—S. WEIN.

Local Union 306 and RCA Organize School

FOLLOWING negotiations with Sam Kaplan, President of Projectionists' Local No. 306 of New York City, arrangements have been made for a special course of instruction for projectionists of the New York district to be held at the Service and Installation Department of RCA Photophone, Inc., No. 438 West 37th Street, New York City.

A meeting held at the same place was attended by Vice-President C. F. Eichhorn, Secretary Frank Day and Business Agent Simon Terr of Local 306; LeRoy Cox, chief projectionist of RKO; Harry Rubin, chief projectionist of Publix Theatres, and about 150 projectionists from various New York theatres.

Plan of Instruction

During the meeting definite plans were made for classes, assignments, lectures and demonstrations. The first of these lectures and demonstrations was presented at that time by H. B. Braun and A. R. Schulze and was very favorably received by all present. The regular school course got under way Thursday, December 12, on which date two groups of twelve men each received personal instruction on the subject of the RCA Photophone Soundhead and were given reading matter, containing illustrations, for study in the week intervening between the first and second instruction periods.

It is planned to continue these lectures and instruction periods until every projectionist in the territory covered by Local No. 306 has acquired a thorough working knowledge of Photophone equipment. RCA Photophone, Inc., feels that arrangements made will be beneficial to all persons connected with sound projection and is planning the establishment of similar schools in other cities.

Scranton L. U. Elects Officers

The following have been elected officers of Local Union 329, Scranton, Penn., for the year 1930:—John Peep, President; Fred Hopf, Vice-President; Glen Ornstein, Fin. Secretary; Joseph Namitka, Rec. and Corr. Secretary; George Miles, Treasurer; Samuel Kessler, Business Agent. Trustees for the coming year are Harry Granville, Joseph Smith, and Harry Litts.

"Rain" in Motion Picture Film

By H. B. BYRON

SCRATCHING and abrasion of the working surface of motion picture film is one of the most serious problems with which the industry has to contend. The seriousness of this problem, however, is not apparent from any concerted effort on the part of any unit or units of the industry to solve this problem. There is much pondering of the subject, not a little talk about among those who are familiar with the problem but very little, if any constructive effort is or has been expended to work out any constructive plan of action. This trouble usually comes to the attention of projectionists by reference to the word "rain," a term which is a misnomer and wholly misleading.

So fundamental is this phase of motion picture reproduction that not even many projectionists, the very men who have to contend day in and day out with the problems arising from poor film condition, are at all familiar with the causes of this trouble. This paper will attempt to set forth the real causes of "rain," and a subsequent paper will offer the solution.

"Rain" is very costly to the motion picture business, although this fact is not generally known. The effects of this condition on sustained attendance at picture theatres is difficult to estimate, but we may be sure that a poor presentation of film resulting from bad film is reflected in the box-office in the long run. Eyestrain is one of the outstanding effects of "rain," and the loss incurred by the industry from this annoyance and irritation is considerable.

Naturally a poor presentation is always charged up to the projectionist, irrespective of conditions; but anyone who is at all familiar with the problem of bad film will realize that the projectionist is wholly blameless in the matter. This is said not in defense of the projectionist, because the writer feels that the high quality work now being done in a majority of projection rooms precludes the necessity for any such defense. Then, too, the solution of the problem lies not with the projectionist but with the producers.

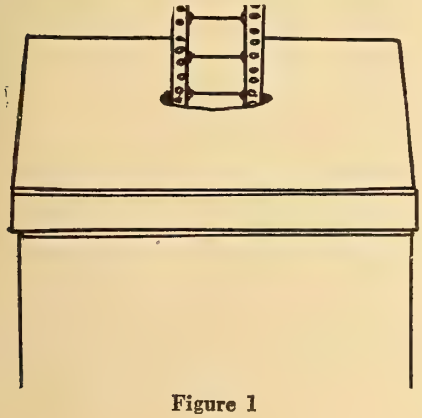


Figure 1

Static Electricity

The first factor in the cause of "rain" is *static electricity*, the second is grit and dust; and the results of the combination of these two forces are indeed serious. The writer cannot recall ever having seen a comprehensive presentation of the causes and remedies for "rain," and he believes that the present paper will offer a wholly new viewpoint on the subject.

What may seem to be but a commonplace trick but one which is a classic experiment in physics may be cited here as illustrative of the principle of static electricity. If the reader will take an ordinary comb, preferably one of celluloid, and draw

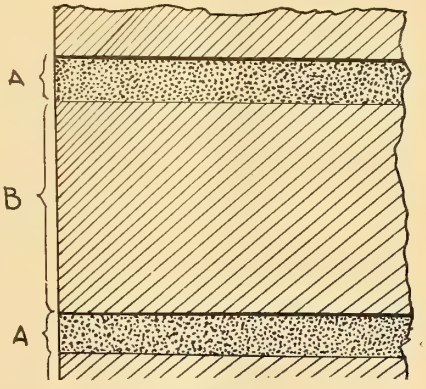


Figure 2

it through his hair a few times in rapid succession; then place a match or toothpick on the palm of the hand and bring the comb close thereto, the wood will be seen to be drawn irresistibly to the comb. It is, of course, the static electricity generated by the friction of the comb which attracts the wood, often causing it to jump an inch or more.

If the hairs on one's head were as large as forest trees, and the comb proportionally so, the result would be an electrical storm the thunder of which would be deafening and the lightning flashes blinding.

This demonstration will indicate how static electricity present on the film attracts grit, dust and other foreign matter which may be floating in the air near the path of the film. The film is then caught up and carried into the tightly-wound layers of the reel where the dirt and grit are permanently embedded in both the emulsion and celluloid sides of the

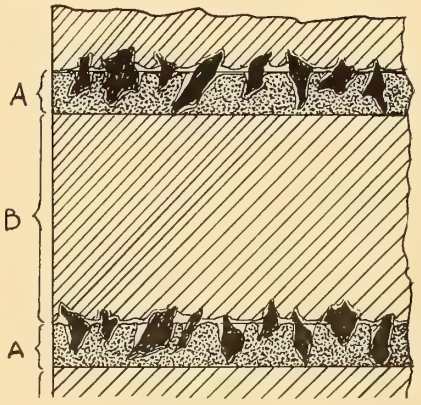


Figure 3

film, there to remain similar to sand in sandpaper, each grain continually cutting its respective furrow, known as a "scratch."

A friend of mine who was a motion picture exhibitor had an interesting experience in the early days of the industry. In those days there were no take-up reels and the film usually was caught in some receptacle such as a clothes basket, a packing case and the like. The amount of dust that was found to accumulate on the bottom of these receptacles was astonishing, and many efforts were made to devise some means for keeping the receptacle tightly sealed and thus, so it was thought, keeping the film clean.

My friend was rather of an inventive turn of mind and he made a sheet metal receptacle of about one foot square and 3½ feet high, a "tallboy." He put it into use with his projector the while remarking that "very little dust will be able to enter the mouth of that tallboy." At the end of the day we looked into the bottom of the receptacle and great was our surprise to find the bottom thereof covered with not less than a half inch of dust. Nothing daunted, my friend proceeded to devise a lid for the receptacle (Fig. 1), which had a very narrow oval opening just large enough for the film to pass through. But at the end of that particular day he again opened the lid to find as much, if not more, dust than before. He probably doesn't know to this day just what the answer to this incident was.

The explanation of this apparent phenomenon is simple:—the film in its course through the projector and into the receptacle collected the dust by means of a charge of static electricity induced by bending, rubbing and shaking in its rapid motion through the projector. When the film piled up in the metal can, which absorbed or

neutralized the static charge, some of the dust was released and settled on the bottom. But in present day practice the dust on film has no such chance to escape from the surface but instead becomes embedded and permanently locked in the surface by the binding clampage of the layers on the reel.

Figures 2 and 3 show what happens to the cinegraphc and phonographic tracks and surfaces of the film through the operation of the static electricity and dust combination. Fig. 2 shows a section through two layers of film as they are contained in the reel. *A* represents a section through the emulsion of a fresh film, while *B* represents the celluloid portion. The small dots through the layer *A* represent the halids of silver which form the image of a picture or the shaded parts of a sound track. This is known to the projectionist as "grain" and are plainly visible as such on the screen during projection. This represents a film in prime condition.

Fig. 3 represents a section through two layers of used film, with the black "arrowheads" or "cobblestones" representing grains of dust or grit which have been embedded in the emulsion, *-A-;* the upper edges of these are seen to be projecting into the celluloid surface of the next layer *-B-*. It will be noted how both these surfaces are distorted by strain on account of the embedded grit. It may be seen how both the celluloid and emulsion surfaces are gashed and furrowed by the grit plowing through them when one layer is pressed taut upon another.

Some of the "stones," it will be noticed, cut entirely through the emulsion, and, of course, the image in the track of these is cut away altogether and only a light streak remains. These furrows afterward become filled with fine dust, and this is the "black rain" so familiar to both audience and projectionist.

It is quite evident that any process of renovation can only remove the dust accumulated in these furrows and cannot replace the missing sound and picture portions; nor will such a process remove the grit embedded in the surfaces, which must necessarily be left there to produce new furrows, due to slippage and cinchage in subsequent take-up and rewind actions.

(*To be continued*)

Standard Nomenclature

II

(*The following glossary of technical terms used in the motion picture industry was formulated by an S. M. P. E. committee and adopted as standard by that organization. Trans. Vol. XIII, No.* 37.)

M

MICROPHONE — A device for conversion of sound into electrical pulsations.

MICROPHONE AMPLIFIER—The first unit in the amplification chain, usually placed close to the microphone.

MICROPHONE MIXER—An assembly of volume controls used for regulating the relative input signals from several microphones.

MILLI-PREFIX signifying the thousandth part of, as in millimeter, millivolt, etc.

MODULATION (Electrical) — The variation of amplitude of an alternating current in accordance with the amplitude of a second alternating current or complex wave. As used in sound recording practice, the superposition of an alternating current on a direct current.

MONITOR—(verb)—To control the volume of sound from a reproducing equipment.

MONITORING LOUDSPEAKER—A loudspeaker located in the recording room and connected with the microphones on the set to permit the recordists to hear the sound being recorded. A similar speaker is placed in the projection room to enable the projectionist to follow the sound reproduction.

MOTION PICTURE—The representation of an object by the rapid presentation to the eye of a series of pictures showing the object at successive intervals of time.

MOTION PICTURE PROJECTOR—A device for suitably projecting motion pictures.

MOVING PERIOD—That portion of the picture cycle during which the film at the aperture is in motion. This period is expressed in degrees of revolution of the flywheel when 360 degrees are equal to one cycle.

MULTIPLE REEL PICTURE—(As applied to 35 mm. film)—A photoplay of too great footage to be placed on a single 1,000-foot reel. In practice a term applied to photoplays requiring more than three 1,000-foot reels to hold it; photoplays of two- and three-reel length being termed "two-reelers" and "three-reelers."

N

NEGATIVE—The developed film, after being exposed in a camera.

NEGATIVE STOCK — Light-sensitive film intended for motion picture camera use.

O

OBJECTIVE—The simple or compound lens nearest an object which forms an image of it.

OBSERVATION PORT—An opening in the wall of a projection room through which a projectionist observes the screen.

OHM—A unit of resistance, reactance and impedance in a conductor to the passage of an electric current.

OPTICAL AXIS—The straight line through the centers of the light source, lenses, diaphragm, etc., of an optical system, to which their planes are in general perpendicular.

OPTICAL SCRATCH—Any particle of dust or mechanical imperfection in the slit will be imaged on the sound track and have much the same effect as a scratch on the sound track parallel to the edge of the film. This is called an optical or shadow scratch.

OPTICAL WEDGE—A device which varies progressively in absorption of light from end to end. Sometimes used as a device for varying exposure in sensitometry.

ORTHOCHROMATIC EMULSION — One which is made sensitive to yellow and green as well as blue and violet.

ORTHOCHROMATIC PHOTOGRAPHY — Photography in which colored objects are rendered in monotone according to their true visual brightness.

OSCILLOGRAPH—A device for recording vibrations of high frequency.

P

PANCHROMATIC—Referring to emulsions which are made sensitive to the entire visible spectrum.

PHASE—In uniform circular motion, simple harmonic motion, or in the periodic changes of any magnitude varying according to a simple harmonic law (as sound vibrations, alternating current changes, etc.), the point or stage in the period to which the rotation, oscillation, or variation has advanced, considered in its relation to a standard position or assumed instant of starting.

PHOT—A metric unit of illumination. It equals one lumes per square centimeter.

PHOTO ELECTRIC CELL—A cell consisting of a sensitive surface as the negative electrode and a positive electrode between which electrons will flow when the sensitive surface is illuminated.

PHOTO ELECTRIC EFFECT — The emission of electrons resulting from the action of light.

PHOTO ELECTRIC SENSITIVE SURFACE —A surface which emits electrons under the influence of radiation of certain frequencies. The threshold or minimum value of the frequency necessary to produce photo electrons depends on the composition and the nature of the surface.

PHOTOMETRY—The measurement of light.

PHOTOPLAY—A story in motion pictures.

PHOTO SENSITIVE SURFACE—Any surface that responds to radiation.

PICTURE CYCLE—The entire series of mechanical operations which takes place between the positioning of one frame of a motion picture film and the positioning of the next frame.

POSITIVE—The developed film, after being printed from a negative.

PROJECTIONIST—A person skilled in

(*Continued on page* 41)

Subtractive Color Cinematography

By PROFESSOR RODOLFO NAMIAS*

THE only process of color cinematography which has so far been put into practice is the process whereby the analysis or selection is limited to two colors and synthesis is obtained by superposing two series of monochrome images—one red and the other green. A single film takes the two perfectly coincident images, the red on one side and the green on the other.

The images are of normal dimensions and the film is projected by the usual apparatus, the only requisite precaution being to ensure that there be plenty of light, in view of the greater opacity of these color films as compared with the usual ones.

Patent Considerations

No description of the processes by which such bi-chromatic films are obtained has been published, nor can the process be protected by patent, since the principle of selection, like that on which the synthetic process is based, is public property. The technique to be followed for the production of such films has been reconstituted by the author in these notes, in the light of an examination of several pieces of bi-chromatic film and of a number of experiments.

It is clear that, while we may be able to lay down the technical bases of the several operations and more especially to give particulars regarding the production of the two series of monochromes, it is impossible to say anything on the mechanical part of the process, which must undoubtedly present difficulties; these however are not so formidable that they cannot be overcome in laboratories specially devoted to mechanical cinematography.

The Negative Film

The first question that naturally arises when observing these two-color films relates to the negative film from which they are produced. How was this film obtained? Was it made on one and the same film, by alternating the two images through a green and orange colored screen? In this case it would hardly be possible to obtain the perfect coincidence of the two successive images, especially where a subject in rapid motion was photographed: and yet the writer has been unable to trace by even microscopic examination defects of coincidence in any two-color images. It is true however, that in none of the films observed did the subjects or scenes represented suggest that there had been any rapid movement.

Or were two objectives used and superimposed one on the other, thus obtaining simultaneously two images through two selective filters on the same film?

In this case, however, it would be requisite to arrange for the slight convergence of the two axes of the objectives or to adopt General Russo's system to remedy the phenomenon of parallax. We should still, however, be faced with the difficulty of having to change a portion of the film corresponding to a double normal image, involving a somewhat vigorous pull on the film.

The first system is the simpler and, in the case of staged scenes, it would not appear to be difficult to restrict the movements of the subject to an extent that would obviate any perceptible displacement of the two consecutive images.

While we can do much to adapt the movements of the subject to meet the needs of the two-color process, as much and more can be done in the matter of color. It should also be added that since it is possible to realize the complemental character of white with pairs of different filters, the color of light screens in the bi-chromatic process, is less restricted than in the three-color process. The importance of completing the white is moreover relative, since everything depends on the sensation of the eye, which receives the impression of white from a ½ watt electric lamp, though it differs not a little from daylight, being much poorer in blue and violet rays, as we can note by observing a blue or violet colored object at night by artificial light.

It may be said that the pair of screens used in bi-chromatic photography may be varied somewhat according to the subject and that while, in staged scenes taken by artificial light, it is expedient that the green screen should tend to blue, yellowish-green screens are to be preferred for three color photography of open air scenes, the deficiencies in blue covering being counteracted by means of the complimentary exposure under white light.

Illusion and Relief

While we ask of the ordinary cinematograph to give our eyes the illusion of form and movement, color cinematography by whatsoever process it may be realized must give us a sensation that increases the illusion and approaches nearer to the truth; this does not depend entirely on the more or less faithful rendering of color, but also on the fact that, thanks to variety of coloring, the details of a picture, which would be merged in the usual chiaroscuro image, stand out.

A color projection, though the colors may be but approximate, so long as they are the result of selection and are not merely applied by hand (as they were in the Pathé-Color process that has now well nigh died out), affords not only the suggestion of color, but also of relief.

And here it is fitting to make a comparison with the still projection of natural scenes, in which the effects of relief, atmosphere, and distance are considerably enhanced when the ordinary slides are replaced by colored slides obtained by the autochromatic, tri-chromatic, or bi-chromatic process.

If it is true that the sensation of relief in respect of near subjects is in large measure due to binocular sight, it must also be considered that the effect of atmosphere and distance in a landscape is due entirely to the gradual training of the eye, whereby it transforms automatically, in the brain, the fading and variation of color into the sensation of distance.

Thus, even failing the much desired invention of a stereo-cinematographic process (an invention that has been repeatedly heralded but the possibility of which seems remote, when considered apart from complicated systems of separate vision by the two eyes), the introduction of even approximate processes of color cine-

(*Continued on page* 40)

*Rome, Italy.

G. Harry Brophy

G. Harry Brophy, who for many years has been President of Local Union 253, Rochester, N. Y., died at the Strong Memorial Hospital in that city on December 9 after a short illness of pleuro-pneumonia. Funeral services for the deceased were held in Rochester on the night of the 10th, after which the body was sent to York, Penna., for interment. Brother Brophy was survived by his mother who resided in York, the birthplace of the deceased.

G. Harry Brophy was one of the most popular members of the International Alliance, and in his many years of service to the Rochester Local Union he made a host of friends both in and out of the labor movement. The present strong condition of Local Union 253 is attributed by its members to the untiring efforts of Brother Brophy during his officership.

The Three-Element Vacuum Tube

BY EDWARD W. KELLOGG*

MANY factors essential to a successful talking motion picture owe their existence largely to the vacuum tube amplifier. I have in mind in particular high quality loud speakers. These owe their existence to the amplifier tube; first, because without the ample power and high quality voice currents for their operation which amplifiers can furnish, the loud speaker development would have been extremely difficult; and secondly, because the vacuum tube is the foundation of popular radio reception, and without the stimulus of this field of application loudspeaker development would not be near where it is today.

Figure 1 illustrates the manner in which a tube is connected when it is used for amplification. It is customary to measure the plate voltage and grid voltage, using the negative filament terminal as the reference point. The hot filament gives off electrons which are negative charges of electricity. These are repelled by the grid which is negatively charged compared with the filament, but they are attracted by the plate which is positively charged.

Owing to the proximity of the grid, the electrons surrounding the filament are more strongly affected by the grid potential or voltage than by that of the plate, or, in other words, a small change in grid voltage has as much effect on the escape of the electrons as a much larger change of plate voltage. Nevertheless, owing to the holes through the grid the plate voltage does have an effect on the movement of the electrons within the space between filament and grid. All of the electrons which pass through the meshes of the grid are carried to the plate, but the number which thus escape to the plate depends jointly on the voltage of the grid and that of the plate.

Grid and Plate Potentials

In a tube of given construction, a change of one volt in grid potential has as much effect on the number of electrons reaching the plate as a considerably larger number of volts change in plate potential. For example, referring to Fig. 1, if the grid potential were changed from —4.5 to —5.5 volts, the plate current would be reduced, but if the plate potential is now raised from 90 to 97 volts, the plate current will be brought back to its original value. We should then say that 7 volts change of plate voltage is equivalent to 1 volt change of grid voltage. This ratio is known as the *amplification factor* and is designated by the symbol u.

If the current is supplied to the plate through a very high resistance, so that the voltage consumed in the resistance is large compared with the tube plate voltage, the plate current can be held practically constant. Under these circumstances any change of grid potential results automatically in the compensating change in plate voltage.

Figure 2 shows the connections of a resistance-capacity coupled amplifier. In applying the change in plate voltage of the first tube to the grid of the second tube it is customary to interpose a capacity C. This makes it possible to connect all of the filaments to the same set of leads, but since the first plate is at a potential of say +73 volts with respect to the negative filament and it is desired to have the grid of the second tube at an average of —4.5 volts, it is necessary to interpose a device across which a constant voltage 77.5 volts can be maintained. For certain special purposes a 77.5 volt battery might be used in place of the condenser shown, but if the voltage of the plate of tube No. 1 goes through a rapid change and returns to its original value, the size of condenser C can be so chosen that its charge will not change appreciably during this interval, and under these conditions it accomplishes just what a battery would accomplish; that is to say, it keeps the plate of No. 1 tube and the grid of No. 2 tube at a fixed voltage difference, thus transmitting all of the fluctuations while permitting grid No. 2 to vary above and below the desired average of —4.5.

The grid leak resistance R2 serves to keep the grid at the desired average potential. This must be a high resistance for two reasons: (1) If it is a low resistance, it will constitute a useless load and reduce the amplification obtained, and (2) a low resistance will permit too much change to take place in the charge on the condenser C.

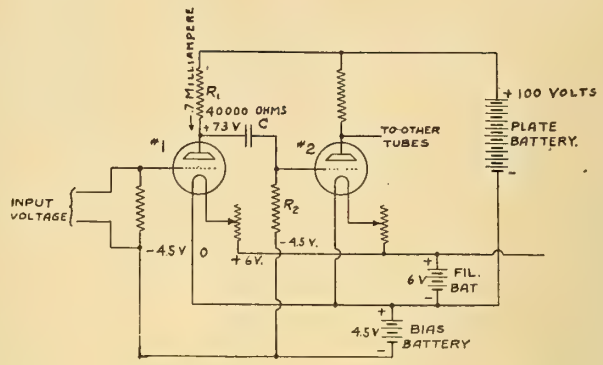


Fig. 2. Portion of resistance — capacity coupled amplifier.

Transformer Coupling

Figure 3 shows schematically two tubes connected by means of a transformer. When a voltage is supplied to one winding of a transformer, a corresponding voltage is developed in the other winding. This "secondary voltage" may be greater or less than the supplied or primary voltage, depending on whether the second winding has more or less turns than the primary winding. The transformer provides a very convenient method of connecting tubes in cascade for amplification, and by providing more secondary turns on the transformer than primary turns, or "stepping up" the voltage through the transformer, a greater amplification per stage is obtained than that corresponding to the amplification factor or u of the tube itself.

We have shown so far simply how the vacuum tube can amplify voltage. It is now in order to consider how this may be done without causing distortion. The condition for distortion-

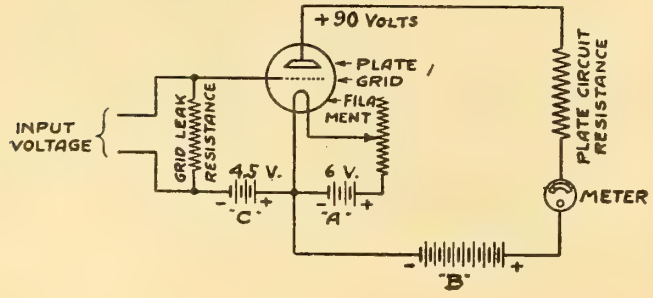


Fig. 1. Conventional tube circuit diagram

* S.M.P.E. Trans., Vol. XII, No. 36.

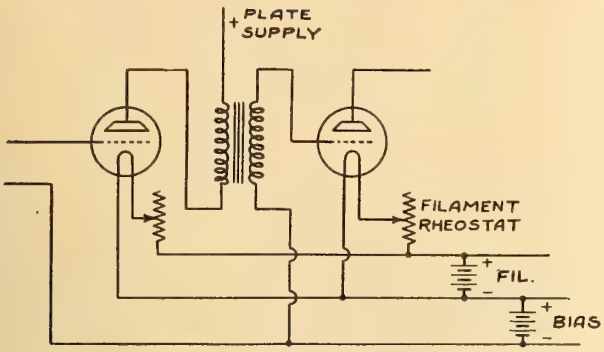


Fig. 3. Transformer Coupling

less amplification is that *the total amplification must be constant.* This is a brief statement which may need considerable explanation. There are two factors on which the constancy of amplification ordinarily depends: (1) the magnitude of the voltage changes which are to be amplified, and (2) the rapidity of these changes.

Consider first the condition that the amplification shall be independent of the magnitude of the voltage change. Let N designate the total amplification from the grid of the first tube to the plate of the last tube of the amplifier. Changing the input voltage from —5 to —4 will result in a change of N volts at the output, and changing the input voltage from —9 to zero must, if the amplification is constant with respect to magnitude, produce a change of $9N$ volts at the output. Likewise any one volt change of grid potential at the first tube must produce a change of N volts at the output terminals whether that change is from —9 to —8, —5 to —4, or —1 to zero.

It is, of course, impossible to make such a condition hold true except between certain limits, and I am taking the limits, for purpose of illustration, as —9 and zero volts at the first grid. The amplifier fulfilling the conditions just described will then be satisfactory provided at no time the input voltage causes the first grid to swing more than 4.5 volts above or below the mean potential of —4.5.

Figure 4 shows the characteristics of a tube plotted in terms of plate current against grid voltage. Curve I is for constant plate voltage. Curves II and III show the plate currents with two values of resistance in the supply circuit. The plate voltage corresponding to any point on one of these curves may be found by subtracting the voltage drop (current time resistance) from the supply voltage. It is evident that curve I represents a condition under which the tube cannot be a voltage amplifier, since the plate voltage is constant. Referring to Curve III and finding the corresponding voltages at the plate as shown by IIIa, we find that the tube is giving a voltage amplification of about 5.5. The condition for constant amplification (i.e., amplification independent of the input voltage) is that the tube shall be used only over such a range of grid voltage that the characteristic, Curve III, or IIIa, is practically straight.

Fortunately a slight distortion is permissible, because the ear accepts some distortion of this kind without judging the quality of reproduction

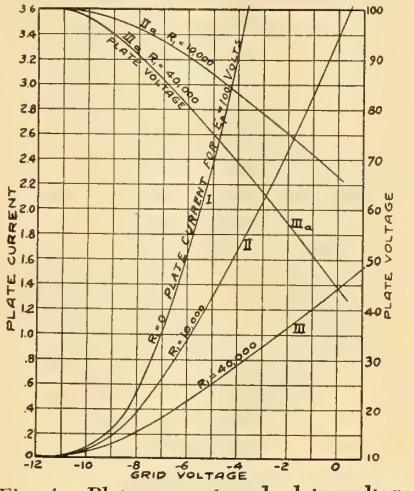


Fig. 4. Plate current and plate voltage as affected by grid voltage; 100 volt supply

to be impaired. It becomes a matter of judgment to determine the exact maximum range to be used. Referring to Curve III, Fig. 4, it will be noticed that the characteristic is nearly straight for values of plate current above 0.1 milliampere or —9 volts grid. Increasing the range of grid voltage to greater negative values would only slightly increase the output of the tube and would very rapidly increase the distortion. A conservative and a liberal estimate of permissible range would probably not differ by more than 20%.

In the actual design of an amplifier it is usually found easy to provide ample margin in all the tubes, except the last stage or perhaps two stages in which the voltage swings become large. The smaller the swing the less is the distortion in a tube due to non-linearity of its characteristic; hence distortion of this kind is usually confined to final stages of the amplifier.

In fixing the range of grid voltage, under which a tube is to be worked, we practically always specify that the grid shall never become positive with respect to the negative end of the filament. So long as the grid is always negative it receives no electrons and absorbs no power from the preceding tube, but the moment its potential becomes positive it constitutes a resistance load across the circuit, and since this load is on during only a part of the cycle, distortion results.

Putting the matter differently, the preceding tube tries to push the grid positive, but the effect is in part neutralized by the electrons or negative charges picked up by the grid. On the other hand, no such opposing effect is encountered when the grid is pushed in the negative direction. The effect on the output wave shape is just as if Curve III in Fig. 4 bent sharply toward the horizontal to the right of the zero grid volts axis. Since the range of grid voltage is always from zero to a certain maximum negative value, means are always provided in properly designed amplifiers to give the grid a mean potential of half of this maximum negative voltage.

The voltage to be amplified is then superimposed upon this average or bias voltage, now adding to and now subtracting from the bias voltage. In resistance-coupled amplifiers this proper bias is established by connecting the grid through a high resistance or grid leak to a point or suitable potential, usually a biasing battery. When a transformer is used, its secondary winding constitutes the conducting path through which the grid is held at the desired bias voltage.

If it is known that a tube has a permissible range many times the actual voltage which it will have to handle, as is often the case with the first stage of an amplifier, it is only necessary to make sure that the bias is somewhat greater than the extreme input voltage swings, so that the grid will never become positive. This bias may be much less than half the extreme negative value which the tube characteristics might permit. The design of amplifiers is conducted with the help of curves as shown in Figs. 4 and 5, but testing is usually carried out by impressing on the input circuit a sine wave alternating voltage and studying the wave shape of the output voltage.

(To be Continued)

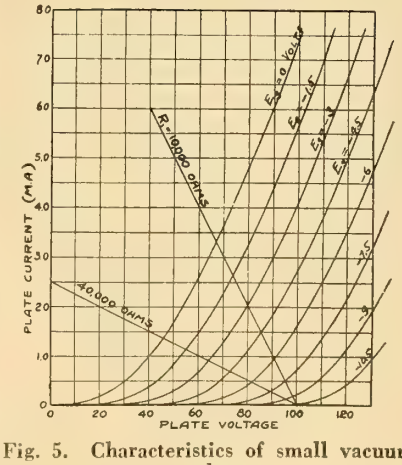


Fig. 5. Characteristics of small vacuum tube

Brilliant Affair for 306 Leader

ONE of the chief assets of Local Union 306, New York City, and a model labor organization educational society is the Kaplan Projection Society. A recounting of the fine work done by this Society since its original formation and subsequent combining with the Manhattan Projection Society, would entail much more space than is available on this one page. Regular meetings are fostered by the Society to which are invited the outstanding men in the projection field to lecture on the various equipments. Typical K.P.S. meetings are those which are attended by more than 500 members who, after a brief business session, are instructed in the very latest developments in the projection equipment field.

In addition to its function as the educational unit of Local Union 306, the K.P.S. takes an active part in practically all the social events of the former organization. One of the most successful of these affairs was the dinner-dance tendered President Sam Kaplan at the Commodore Hotel. More than 1,000 members of Local Union 306 attended this affair to pay tribute to their leader, and a long line of distinguished guests were there to honor their friend and colleague.

Pres. Canavan Toastmaster

An excellent dinner ushered in the affair and from then on until the late hours of the morning there was not a dull moment. Two dance bands played continuously throughout the evening, both during dinner and for the dancing which followed. Music for dancing was continuous, one band picking up as the other finished.

President William F. Canavan of the International Alliance acted as toastmaster for the affair, and he was in his usual fine fettle.

President Canavan gave a short talk in the course of which he charted the course of the International Alliance during the past decade, stressed its growth both numerically and in prestige among American labor union organizations and recounted some of his experiences during his long term of office as International President. Among the honored guests who were introduced by President Canavan as speakers of the evening were the following:



Sam Kaplan, President

Thomas Farley, sheriff of New York County; Morris Bloch, minority leader of the State assembly; Judge Jacob Strahl of the Municipal Court, Brooklyn; Captain Phillips and Vincent Libell of the law firm of Phillips, Mahoney, Libell and Fielding; Charles Sinnigen, Central Union Label Trades Council; Judge Adolph Stern, Bronx County; Bart Green, Dept. of Water, Gas and Electricity, N. Y. City; Matthew Woll of the A. F. of L. and President of the Union Labor Life Insurance Co., Joseph N. Weber, President of the American Federation of Musicians; Harry Sherman, Publix Theatres; Walter Maher, President Local Union 1, N. Y. City; and Sam Goldfarb, Local 1 Delegate.

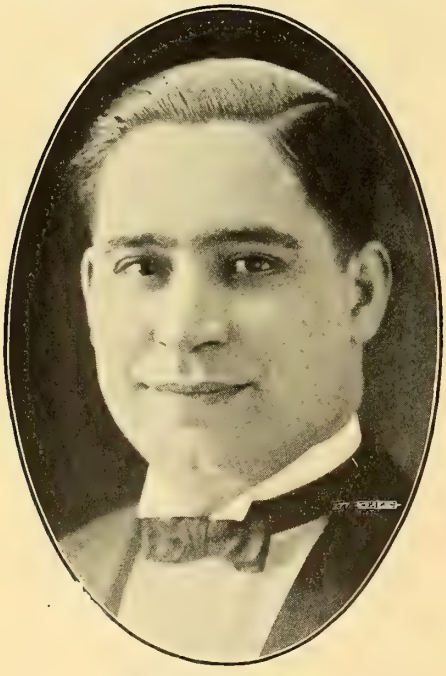
Many Local Unions from the territory surrounding New York City were represented around the dining tables, in addition to many leaders in civic life.

When the last speaker but one of the evening had concluded his remarks, President Canavan arose and informed the gathering that he had an important announcement to make. Precluding this announcement President Canavan paid glowing tribute to President Sam Kaplan of Local Union 306 for his splendid work in moulding that organization into one of the most powerful and model labor unions in the country.

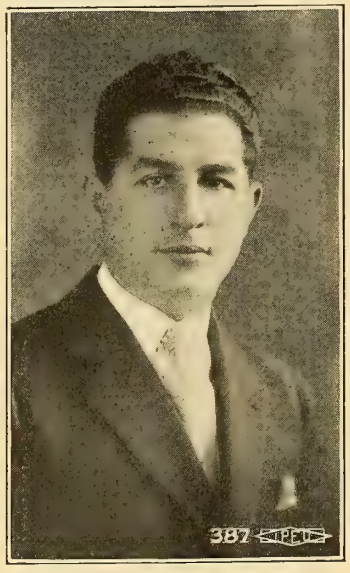
Lincoln Car For Kaplan

Then turning to President Kaplan the toastmaster announced that he was particularly pleased to present

(*Continued on page* 44)



James Lefante, B. A.



Joe Pehar, K. P. S. Founder



Dave Engel, Fin. Secy.

A group of Local Union 306 officials who are also officers of the K. P. S.

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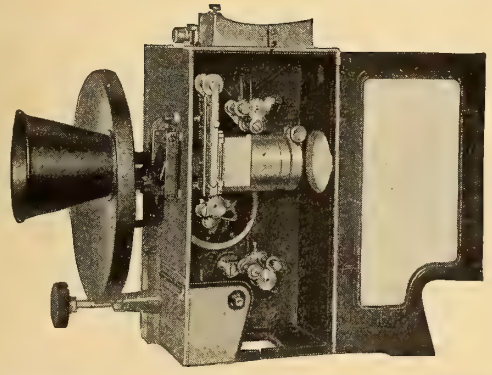
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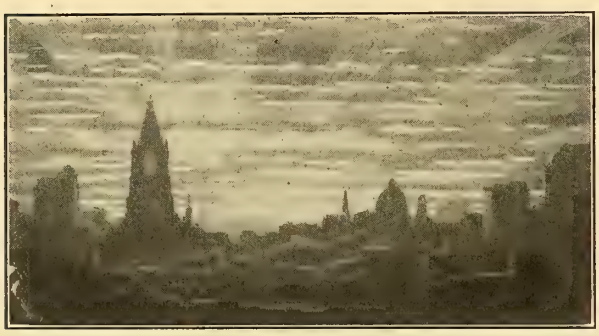
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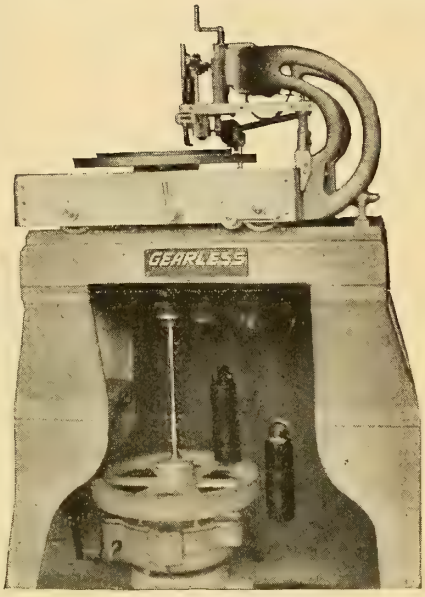
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Everyday Science

Electric Shocks Sort Out Three Different Senses

THAT precisely the same small electric shock may be felt by the human skin either as a blow, a pain or a burn, depending upon the exact spot on the skin to which it is applied, is reported by the Parisian physiologist, M. Georges Bourguignon, in a recent communication to the Academy of Sciences in that city. Using an ingenious instrument by which a shock of graduated intensity can be administered to a localized skin area smaller than a pinhead, M. Bourguignon discovered what seem to be three distinct kinds of nerve endings in the skin, each capable of being stimulated separately and each yielding an entirely different sensation.

Three Senses Affected

One of these consists of the ordinary touch nerves. An electric shock to one of these causes a sensation like a small blow. Another set are characterized as "pain" nerves. A mild shock to one of these produces a tingling sensation; a severer shock is felt as ordinary pain. Nerves of the third kind represent the skin's temperature sense, their electric stimulation causing sensations of heat or cold. These temperature nerves in the skin even possess, M. Bourguignon concludes, special nerve paths to the brain, for to stimulate the ordinary nerve trunks which pass up the arm causes either a pain sensation or a touch sensation, never a temperature sensation.

The nerve fibers which carry temperature sensations to the brain may run, M. Bourguignon believes, through the so-called sympathetic nerves instead of through the ordinary nerves. Ages ago in evolution man's ocean-dwelling ancestors must have possessed, these results suggest, three distinct sets of nervous organs on their sensitive surface. For greater efficiency, nature has combined these three into the single organ of the human skin, but each set of nerves and nerve endings has kept its own individuality.

Work-Cure and Sun-Cure Aid Each Other

Work and sunlight go together, says the famous sun-cure expert, Dr. Auguste Rollier, of Leysin, Switzerland, to cure some of the body's most dangerous diseases, like the dreaded tuberculosis of the bones. Therefore Dr. Rollier and the philanthropists who are aiding his work are building on the sunlit mountain slopes at Leysin a "factory clinic" where even patients who are bed-ridden will be able to work at some interesting and money-making trade while their diseased bodies are exposed to the curative powers of Alpine sunlight.

Special bedsteads have been devised in which patients lie naked in the sunlight but can still work comfortably with their hands. A narrow portion of the mattress can be tilted upward at one end, for example, like a pillow underneath the chest of a patient lying prone, so that chest and chin are supported but the arms left free to use a typewriter, a sewing machine or other tools on a table at the head of the bed.

Power of Sunlight

The effect of sunlight on a bed-ridden invalid is soon evidenced, Dr. Rollier reports, by a tendency of the wasted muscle fibers to fill out and regain their strength, something which he ascribes to improvement in the circulation of blood. Thus muscular strength enough for work is soon restored by the sun and to be working then aids the curative effects of sunlight both on body and mind.

Articles made by patients who are not well-to-do are sold for the patient's benefit. Funds are now being raised for additional sun-and-work facilities.

Sunsets 2,000 Volts Above Sunrises

The electric voltage of a sunset is 2,000 volts higher than of a sunrise. Day and night three vast electric currents, like rapid tidal floods, rush around the spinning earth in layers of the air 80 or 90 miles above the ground. On the night side of the globe there is one electric current, flowing continually eastward and totalling about three million amperes equivalent, at the 2,000-volt potential, to about eight million horsepower.

On the day side of the earth there are two currents, one above the other; the upper current flowing eastward just as does the night-time current while the one below it flows westward.

Unlike Ordinary Currents

Such are the conclusions announced to the American Physical Society by Dr. E. O. Hulburt of the Naval Research Laboratory, in Washington, which laboratory has been engaged for several years in studies of the electric and magnetic properties of the earth which may affect radio communication at sea. These gigantic electric flows in the upper air are not like ordinary currents in wires, Dr. Hulburt believes, but are vast drifts of electrified air atoms, much as similar electrified atoms of neon gas carry the light-producing current through the glass tubes of modern neon signs. The vast electric currents in the upper air probably create some of the variations of magnetic compasses as well as affecting radio transmission and perhaps some of the features of world weather.

Men Easier Hurt Than Women

The conventional insult of slapping an enemy on the cheek was not so badly chosen if the intention was to hurt him, recent investigations of Professor Uginelli of Florence, Italy, have indicated, for human cheeks and foreheads turn out to be the most sensitive parts of the body to pain. Least sensitive, on the other hand, are the outer sides of the arms; perhaps a consequence of the millions of years of evolution during which the outer arm has been used habitually to ward off blows or to protect more sensitive parts of the body.

Senses of Touch and Pain

The sense of pain in the skin is not quite the same, experts know, as the sense of touch. The touch sense is tested by determining how close together two points like pin-points may be and still be distinguished as two separate points instead of one. Sensitivity to pain, on the other hand, is tested by the severity which a pin-prick or a small pinch or a sharp blow must have in order to seem painful.

Individuals vary in their sensitivity to pain, Professor Uginelli finds, just as one individual's pain sense differs on different parts of his body. Contrary to the conventional idea that women form the more sensitive sex, another conclusion from Professor Uginelli's tests is that women feel pain about one-tenth less severely, on the average, than do men.

Relative Efficiencies of Steam and Hydro-Electric Stations

In generating electricity from coal, even the largest and most modern electric power stations are able to utilize only about 25 per cent of the heat units available in the coal. Much of the heat is lost in the condensing water, a large part of it goes up the stack, and the remainder escapes by radiation from the pipe and steam apparatus.

Operating Costs

Thus, while theoretically a pound of coal containing 13,700 heat units might produce four kilowatt-hours of electrical energy, in some yet undiscovered chemical process, it now produces only one kilowatt-hour in the most modern stations. On the other hand, modern hydroelectric machinery now transforms into electricity more than 90 per cent of the energy in falling waters, leaving little opportunity for radical improvements in present day hydroelectric practice.

The constant improvement and advancement in the art of steam genera-

tion makes the useful life of a steam plant less than that of a hydraulic plant, and larger amounts for obsolescence must therefore be added to the operating costs. On the other hand, there is the opportunity for greater future reduction in the cost of steam power than in the cost of water power.

New Machine to Keep Patients Breathing

The recent cases where relays of men have worked for days providing artificial breathing for persons so injured or diseased that they could not breathe for themselves, have led Bellevue Hospital, New York, to install a newly invented machine which will do this electrically for as long as may be necessary.

The sufferer from drowning, electric shock or gas asphyxiation, who does not recover with first-aid artificial respiration, given at the scene of the accident, may be brought to the hospital (the "Schaefer prone pressure method" being continued in the ambulance) and placed in the machine.

Forced Respiration

The patient's body is put in a great metal cylinder, with the head coming out through an opening that is cleverly made air-tight without clamping the neck dangerously tight. Compressed air is then forced into and out of the cylinder by the electric machinery, in such a way that the chest is alternately compressed and expanded, forcing the lungs to work, at the normal rate.

Machinery Tireless

The electrical machinery can continue its work indefinitely and there are none of the dangerous pauses which sometimes occur when relays of workers change places in artificial respiration. The device was developed at the request of a committee representing the gas companies of New York City, whose records show that many lives are saved by long-continued artificial respiration, while the man-power efforts that are too soon given up result in the loss of some patients who could have been saved.

James Maxwell's Discovery of Light Waves

"No one could converse with him for five minutes without having some perfectly new ideas set before him." The boys called him "Dafty," but his father recognized in James Clerk Maxwell the kind of ability that outstretched so greatly those of equal age.

In 1831, the year when Faraday discovered the principle of magnetic electricity that led to the dynamo, James Clerk Maxwell was born. At fifteen, a paper on mathematics written by him attracted the notice of the Royal Society of Edinburgh.

"What's the Go o' That?"

His question as a child—"What's the go o' that?"—seems to have drawn him through life. He questioned the common belief that electricity got from point to point because magnetic matter on the surface of connecting wires or other conducting surfaces, attracted it out of the ether. He demonstrated mathematically that electro-magnetic action travels through space in the form of transverse waves, like light, and at the speed of light.

Hertzian Waves

Heinrich Hertz gave physical proof to Maxwell's undying mathematical discovery—that these waves were created and went forth the same as light does. Known as Hertzian waves, they are the basis of wireless communication, radio. Really the same waves as light waves, but invisible, their traveling speed is identical while their vibrating speed is outside the range the eye registers. The union of radio hearing with seeing in television shows how these waves are allied.

Maxwell's Color Box

While professor of Natural Philosophy at King's College, London, neighbors whispered that Maxwell sat in the window of his home staring into a black coffin for hours day upon day. The coffin was Clerk Maxwell's color box.

With this invention, he showed that any given color could be produced by combining three colors selected from different parts of the spectrum. The three base colors corresponded to three sets of nerves or sensations in the eye, each excited proportionately to the amount of its color in the blend of three. Absence of sensation in the eye to any one of the three colors, was shown to be the cause of color blindness.

Clerk Maxwell demonstrated that there are invisible electric waves like light but without the power of illumination.



From Fox "Now"

Nightmare of a sound engineer

Film Fire Statistics

Seventy-one per cent of all theatre fires originate in the projection room while machines are in operation, causing hundreds of fires annually and resulting in a yearly loss of approximately $3,000,000 to theatre properties and equipment. Losses sustained from destroyed film in theatre fires, which are not included in the $3,000,000 total, would send this figure considerably higher.

Theatres suffered an $18,000,000 loss during the five years from 1922 to 1926, inclusive, with the average for recent periods being lower, due, principally, to the many new devices and types of equipment now being built to eliminate fire hazards.

Brain Able to Make One Fat or Thin

A special nerve center in the brain to decide whether a person is to be fat or thin is the newest discovery of two German physiologists, Prof. Wilhelm Grünthall and Prof. Erich Grafe of Rostock University. This center probably controls, their experiments on animals have indicated, the rapidity with which a human body uses the energy of food. This is what physicians call the "basal metabolism" and which they now test in hospitals to aid the diagnosis of many kinds of disease.

The Gland Theory

Other things equal, a woman whose basal metabolism is high uses up the energy of her food as rapidly as it is absorbed. She probably will be thin. On the other hand, a person with low basal metabolism is apt not to use up surplus food and to be fat, sometimes very fat. Until recently the ductless glands, especially the thyroid gland and the adrenal gland, have been looked to as controlling these differences in basal metabolism. Extracts of these glands sometimes have been given to reduce fatness.

Control by Brain

Many physiologists have begun to suspect, however, that these glands are not entirely independent organs but that they, like other parts of the body, must accept control by the brain. Profs. Grünthal and Grafe, by their invention of a new way of injecting a solution of silver nitrate into one tiny spot of the brain of an experimental animal, have been able to stop the working of that small brain spot without damaging the brain anywhere else.

In this way they have located a minute nerve center in the lower part of the brain, destruction of which lowers the animal's basal metabolism by two-thirds or more. Some of the animals thus treated become exceedingly fat. It is not improbable that exceedingly fat human beings may owe that condition to some accidental disease or injury of this same nerve center.

New Advances in the Art

Develop A Non-Intermittent Projector in England

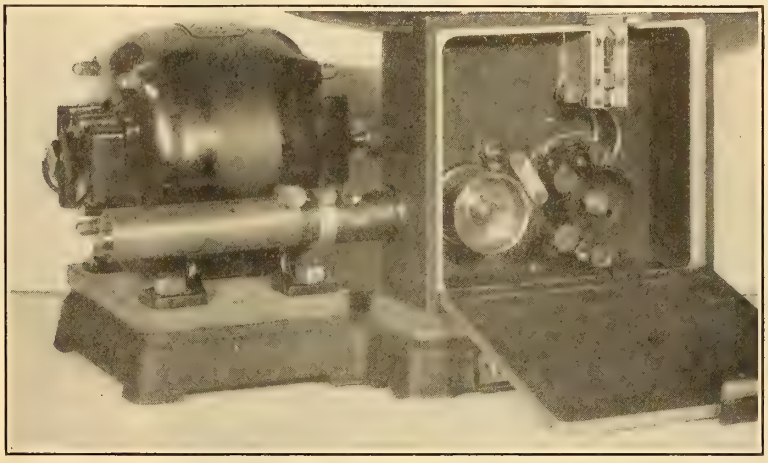
A NEW projector, claimed to have no intermittent movement, was recently demonstrated at the laboratory of its inventor at Kingston-on-Thames, near London, England. The projector is being marketed by Photo-Vision, Ltd., and is called the Continuous Motion Projector. Among the three major problems, claimed to have been solved with this new projector is the fact that it enables the sound track to be placed on the margin of the frame to which it refers, instead of 19 frames away, it eliminates the possibility of buckling in projecting wide films and that it does away with strain on film making its projection life almost unlimited.

No Mirrors or Prisms

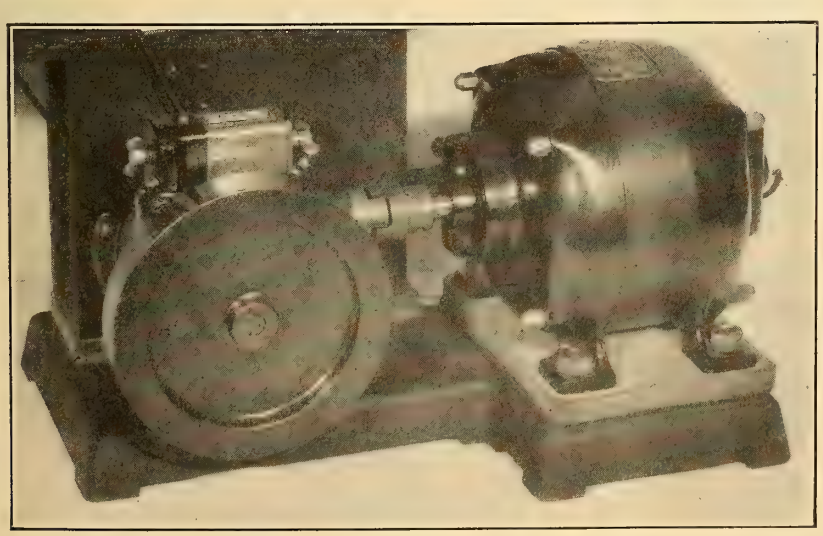
The projector was developed by Messrs. Roberts, Campbell and W. E. John and according to its inventors, it is now possible without the aid of mirrors or prisms to project a continuously moving film by a direct beam. The projector works with the aid of a series of lenses arranged in a channel formed like the letter "D." These lenses are kept equidistant by the construction of their mounts.

The lenses are driven round in their groove, keeping pace with the film which runs parallel to the straight portion of the "D" shaped groove, and each frame in the film is opposite to one of the lenses. By the action of the mechanism, it is claimed, each lens keeps with its particular picture until it passes out of commission at one end of the straight channel, to return by the curved part of the "D" to the other. By adjusting the size of the gate, one, two or three frames may be projected simultaneously. The images of each of the lenses are received on a large master lens, which combines them into one single image. This master lens, which is stationary, fixes the optical center, and causes the two or three moving frames to be superimposed on the screen in one perfectly stationary and flickerless picture.

The first optical advantage obvious at the demonstration of this system was a sense of visual ease, due partly to the fact that movement is seen as transitional from one position to another, instead of jumping from one-point to the next, and partly to the entire absence of alternating periods of light and darkness, which is a fundamental disadvantage of the intermittent system.



Front view of New Contner sound film recorder



Driving mechanism of New Contner recorder. Mr. Contner is associated with Blue Seal Products Corp.

New Type Fader

This new fader which the Operadio Mfg. Company has recently incorporated in their line is of the 12-contact point type. Unlike the usual potentiometer type, each contact represents a definite wire-wound resistance, insuring at all times a constant and positive increase or decrease of amplifier input voltage, and is not subject to deterioration with use or fluctuation in value, due to temperature or weather changes.

Each side is arranged with steps scientifically graduated so that when a switch-over is made from left to right, there is no sudden "click" or rush of music so undesirable in a fader. This fader is adapted for high impedance lines, being particularly suited for fading between pick-ups of 2,000-3,000 ohms impedance.

The fader itself is mounted in a steel box, provisions being made so that conduit wiring can be run right into the box, thus meeting the Board of Underwriters' specifications.

The fader itself incorporates a change-over switch enabling it to work on either disc or sound-on-film equipment. Everything in the construction of the fader is of the very best. It is a real, positive-working fader.

It is also equipped with a dummy fader, coupled with the fader through a set of gears, which is known as Model No. 341-D. The dummy, in outward appearance, is exactly the same as the fader itself with the exception that the switch is left off.

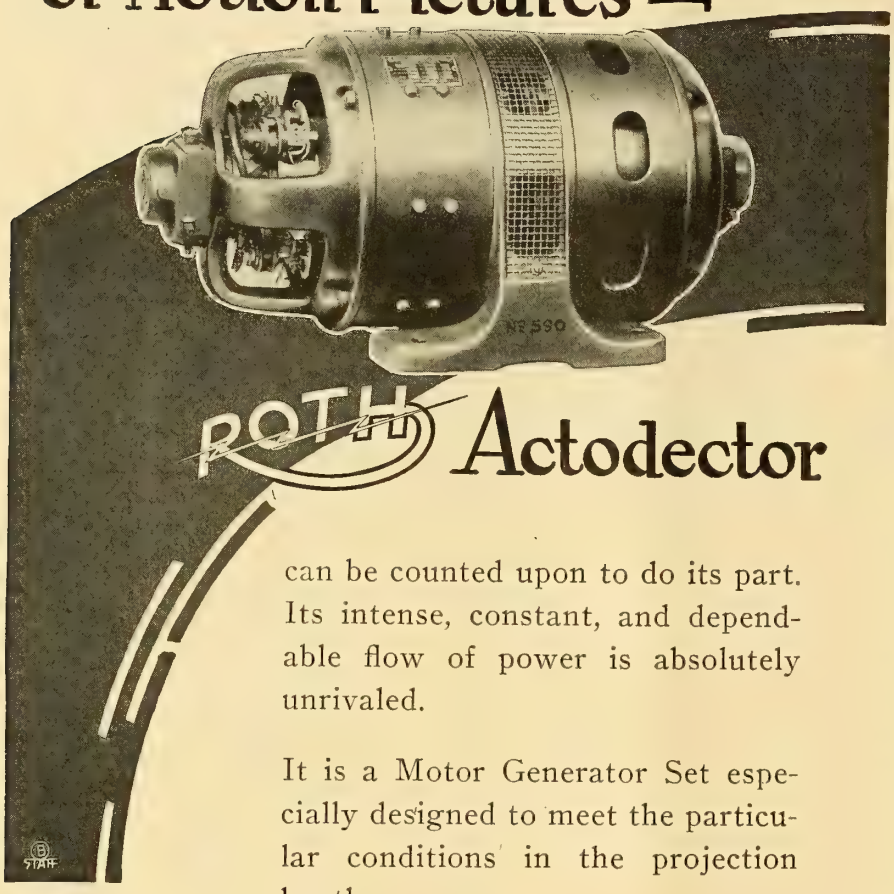
Double Screen Grid Tube Now Reported

A new tube is reported to be in the finishing process in development laboratories. It is described as a double screen-grid tube, intended to be ready for the public next season. Only one additional wire would be necessary in the receiver and this would provide the bias for the second screen, the tap for which would come from the base of the tube.

This bias may be 7½ to 12 volts positive. The intended circuits used will be similar to those now in vogue

(*Continued on page* 48)

For the *Efficient* Projection of Motion Pictures



ROTH Actodector

can be counted upon to do its part. Its intense, constant, and dependable flow of power is absolutely unrivaled.

It is a Motor Generator Set especially designed to meet the particular conditions in the projection booth.

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Complete Sound Picture Service!

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Color Cinematography

(*Continued from page* 31)

matography will enhance the impression of relief and of distance.

The manner in which bi-chromatic cinematography has been applied to medicine by means of the clever Busch apparatus proves that, notwithstanding the incompleteness of the sensation, the effect obtained is much more demonstrative than anything that can be obtained by ordinary cinematography, and the greater truthfulness of the picture certainly produces the effect of making the details stand out with greater relief.

Positive Film and Printing

A film of celluloid coated with a double stratum of sensitive emulsion, one on either side, is unquestionably the kind best suited to bi-chromatc cinematography. The usual emulsion employed for cinematographic positive films intended for ordinary projection is used. But two circumstances must be allowed for in printing the positives, one of a mechanical and the other of a physical nature.

The printing machine must allow a single series of images to be printed on each side of the film; hence it follows that the two films—the negative and the rough positive—cannot be printed in the ordinary way, it being necessary to jump one image:—only by this means is it possible to print one one side a continuous series of images intended to supply the monochrome red and on the other the monochrome green series. This does not involve any very arduous mechanical problem, but it is obviously necessary to have a printing machine which allows the negative films to be moved at just double the speed of the rough films.

Fixing Process

This latter difficulty is completely eliminated by dyeing the emulsion yellow; thus for instance a slight degree of coloring with tartrazine yellow removes the difficulty without affecting the print, while the yellow coloring disappears entirely in the course of developing, fixing and washing the film. Or again a stratum of hydrate of bi-oxide of brcwn manganese, precipitated in the emulsion, renders the stratum quite opaque, while the manganese composition can very easily be removed by using a solution of hyposulphite containing a sufficient quantity of bi-sulphite of sodium for fixing.

The development of double-faced films calls also for some special arrangements which are quite easily made.

By recourse to the methods above indicated, we obtain a positive film bearing a double series of black images, one on either surface; each of these series of images must afterwards be converted into the corresponding monochromes.

Standard Nomenclature

(*Continued from page* 30)

the art of projecting motion pictures.

PROJECTION DISTANCE — The distance between the projection lens and the surface upon which the image is focused.

PROJECTION LENS—The objective which forms upon the screen an image of the lantern slide, film, or other object under examination.

PROJECTION PERIODS — The total fraction of the picture cycle during which the picture is being projected.

PROJECTION ROOM—A room or enclosure from which motion pictures are projected.

PROPS—Contraction of properties. Objects used as accessories in a play.

R

REACTANCE—That property of an electric current which tends to oppose a varying current within the absorption of energy.

RECORDER MARKER—The device for marking the sound negative.

RECORDING AMPLIFIER — A power amplifier used to operate the recording galvanometer.

RECORDING DRUM—The drum over which the film runs as it is exposed in the recorder.

RECORDIST—Operator of the sound recorder in commercial practice.

REEL—(a) The flanged spool upon which film is wound. (b) An arbitrary unit of linear measure for film —approximately 1,000 feet.

REFLECTING POWER OF A SURFACE—The ratio of the reflected intensity to the incident intensity.

REFLECTOR ARC LAMP—In a motion picture projector, an arc light source in combination with a reflector, to project the light beam through the aperture.

REGISTER—To superimpose exactly.

RESISTANCE—The property of an electric circuit which tends to absorb energy due to the passage of a current.

RESONANCE—Reinforcement of a sound by sympathetic vibration of a material of the same natural period.

REVERBERATION — The persistance of sound in an enclosed space. It is measured by the time required for the sound to decrease to one millionth of the initial intensity.

S

SAFETY FILM—Film which is less inflammable than the ordinary nitrate film.

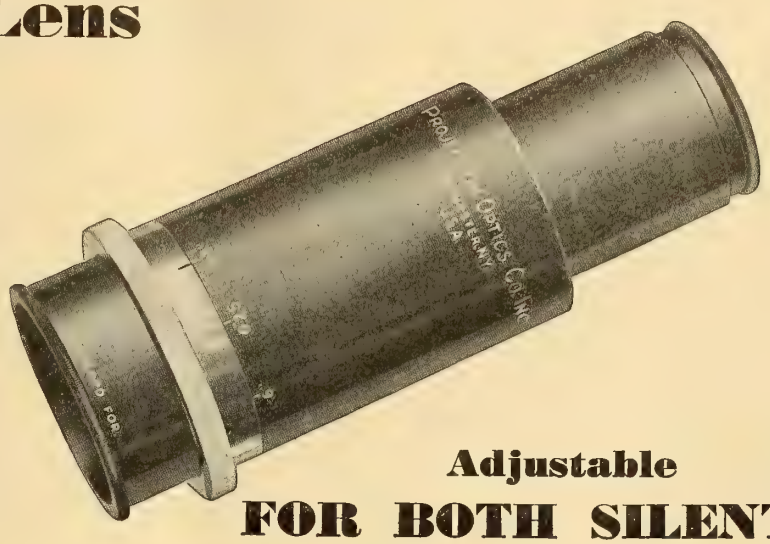
SCREEN—The surface upon which a picture is optically projected.

SENSITIVITY—(electric)—The relative efficiency of a device whose response is of a different character from its excitation, such as a microphone or photo electric cell.

SENSITIVITY—(photo)—The property of photographic emulsion to be

(*Continued on page* 50)

F/2.5 BI-FOCAL Super-Lite Projection Lens



Adjustable

FOR BOTH SILENT AND SOUND FILM

½″ & ¾″ Variation in E. F.

AS the name implies this new construction offers the projectionist everything he has been looking for; two focal lengths in one construction.

By rotating the ring on the lens mount the size of the image on the screen can be increased or decreased instantly to take care of the difference between sound and silent film. At the same time an automatic shifting of the center of picture on screen with sound film is provided for.

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U. S. A.

List Common Sound Faults

IN order to establish a criterion as to "noises" caused by faulty projection of sound films, Douglas Shearer, recording engineer for Metro-Goldwyn-Mayer, recently made an exhaustive demonstration for the members of the Academy of M. P. Arts and Sciences sound classes. Single reels of two recent pictures were printed up with the deliberate idea that they were to be maltreated in every possible way. Further, the projection machine through which they were to be run was loosened in every manner which might cause extraneous sounds.

The result was an amazing series of unpleasant noises and other acoustic flaws which very well illustrated what can happen to a perfectly recorded picture if the projection is not equally perfect. Following the experiments, Mr. Shearer prepared the following chart of the noises due solely to bad projection.

Sprocket Noise—Caused when the film pulls over to the left in the projector, allowing the exciter lamp of the light-ray reproducing system to play through the sprocket holes of the film as well as the sound track. The noise is a rather high-pitched buzz, somewhat like a busy door-bell.

Flutter—This is a pulsation in the recorded tones. It sounds as if the speaker is gagging a bit over a mouthful of mush. It is caused by too long or too short loops in the projection machine, or loose pads on the track guiding the film. These things cause both picture and sound track to move in and out of focus.

Frame Noise—The opposite of sprocket trouble. Caused when the film is pulled in the machine too far to the right, running off the sound-track onto the picture itself, playing, so to speak, the picture and the dark spaces between the frames. Sounds like a motorboat at high speed.

Motorboating—Same as Frame Noise.

Overspeed—When the speed is suddenly increased beyond the normal of 90 ft. per min. (33 1-3 R.P.M. for discs), the high frequency sounds are emphasized at the expense of the lower ranges. In other words, the great basso, Chaliapin, would sound like a soprano under excessive overspeeding.

Underspeed—When the projector is suddenly slowed down the reverse of the above occurs. The lower frequencies are emphasized, and Galli-Curci would sound like Chaliapin.

Dirt Noise—Film should always be carefully cleaned after each running, but sometimes an operator is careless. When this happens, specks of dirt form on the sound track. These specks cause variations of sound which are manifested in many ways—squeaks, whistles, fire-cracker noises, etc.

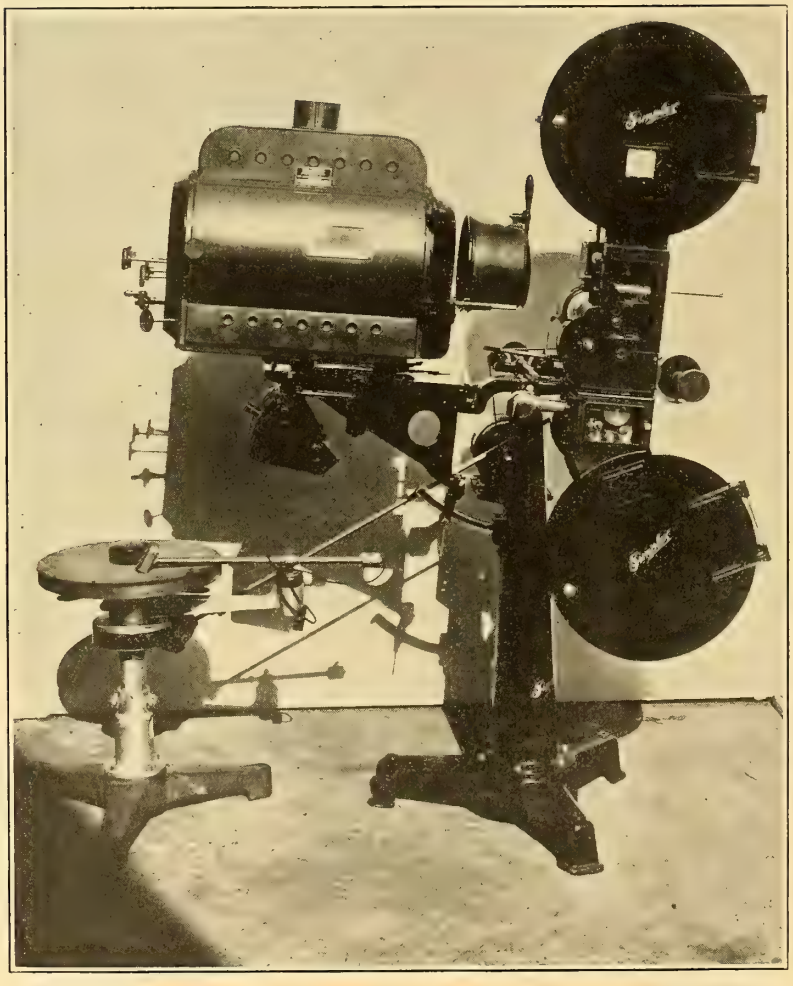
Loose Exciter Lamp—When the exciting lamp of the light-ray sound reproducing system becomes loose there is a distortion of sound, making it hard to keep the attention concentrated.

Gear Noise—Noise recurring at regular intervals, dum-de-dum, etc., can usually be traced to loosened gears in the projector.

Blooping—This is a sudden "plop," usually caused by a bad splice between sections of the film. This can always be avoided by correct splicing, and properly blocking out the spliced patch in the sound track.

Insulation Noise—Some theatres have not yet installed the heavier tripods and insulation pads required for sound reproduction. The amplifying tubes and the photo-electric cell are very sensitive to jar. Sudden "whack" noises from the screen are generally traceable to trouble caused by vibrations when the projectionist walks across a booth in which the insulation has been badly done.

There are other noises which can be caused by accidents and by faulty handling of the equipment, but these are the major extraneous sounds which annoy theatre-goers. All of these sounds can be eradicated.



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Sound reproduction is a carefully developed science and variations from perfection seldom come from any reasons except human carelessness. *When a sound picture leaves the studio, it is as perfect an example of fine recording as the skill and care of the production personnel can make it: if it is properly cared for and carefully projected it should also give perfect reproduction.* — American Cinematographer.

Ed. Note:—The foregoing, with the exception of the last paragraph, is very constructive work, indeed, yet the paragraph in question gives rise to the thought that, in the interests of consistency, it might not be a bad idea for a projectionist now to turn about and prepare a list of those faults which are quite common in recording technique. This listing could be concluded with the admonition (to engineers), that with projection technique so far advanced, flawless recording would positively result in a perfect picture on all theatre screens.

Troubles and Maintenance

(*Continued from page* 16)

phonetics, and once the installation is functioning properly, no trouble will be experienced. If it is not properly designed, the engineer making the installation will demonstrate sufficiently to give you a thorough training in this portion of design.

Crackling may be caused by the following:—loose connections somewhere in the exciting lamp circuit, indicated either by a flicker in the exciting lamp or in the ammeter in this circuit; loose connections in the photo electric cell circuit or in the amplifier battery connections. In "shooting" this trouble, *start at the beginning.* Turn off the exciter lamp. If the crackling ceases, the trouble is there. If the crackling continues, remove the photo electric cell, the cell leak, and the first tube, and continue until the trouble disappears. As soon as the noise ceases, the trouble may definitely be located between the last two elements.

Bad leaks in the coupling circuit of the cell will cause crackling. Remove the defective leak and replace with one of the same value. Use metallic leaks. The rheostat in the exciting lamp circuit is a particularly bothersome element in this respect. Oil-soaked wiring will sometimes cause this trouble. Freshly charged batteries will cause this condition until the gas has leaked off the plates. Remember that a loose fuse in the battery room may affect a circuit just as much as if it was located on the projector itself. When you inspect a circuit, do it thoroughly and then *only one circuit at a time.*

Optical systems have been discussed in detail, and in excellent fashion, by Samuel Wein in these columns, thus we shall discuss only the maintenance aspects of this unit. The majority of optical systems are so designed that the lens assembly can be removed for cleaning without the necessity of realignment. For the benefit of those who have systems that are not so designed, we will give the method commonly employed to obtain correct adjustment. Clean the optical system thoroughly using a piece of lens cloth and replace the lens in the mounting in approximately the same position it was in when removed, so that the slit will be at right angles to the edge of the film. Most lenses have a line or some other designation to show the edge of the slit with reference to the outside of the barrel.

Place the exciter lamp in position and adjust for maximum light at the window where the photo electric cell is normally placed, using a piece of film or the waxed wrapper from the outside of a package of cigarettes to cover the window and act as a screen. Clamp a piece of black film in the film gate and adjust by means of moving the lens toward or away from the gate until the line appearing on the film is sharply in focus to the emulsion side. Remove the film and replace the paper in the photo electric cell window and adjust the exciter lamp until a clear field and maximum illumination is obtained. Be sure that the light beam is at right angles to the edge of the film by catching the beam on the edge of a frame with the film in its true running position.

(*To be continued*)



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Write For Further Information

New Television Developed By Westinghouse

TELEVISION which can be viewed by a room full of spectators rather than by one was announced recently by Dr. Vladimir Zworykin, research engineer of the Westinghouse Electric and Manufacturing Company, to members of the Institute of Radio Engineers. The use of a cathode ray tube as a receiver gives this new type of television many advantages over the well-known scanning disc method of visual broadcasting. The inventor is already in position to discuss the practical possibility of flashing the images on a motion picture screen so that large audiences can receive television broadcasts of important events immediately after a film of these is printed. These visual broadcasts would be synchronized with sound.

No Moving Parts

The cathode ray television receiver has no moving parts, making it more easily usable by the rank and file of the radio audience. It is quiet in operation and synchronization of transmitter and receiver is accomplished easily, even when using a

Brilliant 306 Affair

(*Continued from page* 34)

to the former the gift of the K.P.S. membership the deed of ownership and registration plates for a beautiful Lincoln limousine. (The car was on display in an adjoining room of the hotel and President Kaplan rode in the car for the first time on his journey homeward after the affair.)

As President Kaplan arose to receive the gift the guests broke into a prolonged burst of applause which continued at frequent intervals during his speech of thanks. As a matter of fact, President Kaplan was able to utter little but his thanks, so overcome was he by the enthusiasm of the assembled guests.

What he did manage to say, however, was that his efforts in the past in the interest of the Local Union 306 membership was nothing more or less than a promise that his efforts would be redoubled in the future, and that his sole aim was to weld 306 into one of the outstanding Local Union organizations in the American labor movement. Closing his remarks with a simple yet sincere statement of thanks, President Kaplan announced that the K.P.S. wished him to present several Society officers tokens of esteem. He then presented diamond stick-pins to James Lefante and Joe Pehar, president and founder, respectively of the Society, and diamond rings to Vice-President Dave Engel and Financial Secretary J. Avzar.

Following the presentation of these gifts the guests gathered in the ballroom there to spend the balance of the time dancing.

single radio channel. Another advantage is that, using a fluorescent screen the persistence of the eye's vision is aided and it is possible to reduce the number of pictures shown each second without noticeable flickering. This in turn allows a greater number of scanning lines and results in the picture being produced in greater detail without increasing the width of the radio channel.

The apparatus described by Dr. Zworykin is now being used in experimental form in the Westinghouse research laboratories in East Pittsburgh. A number of similar receivers are being constructed in order to give the set a thorough field test through station KDKA, Pittsburgh, which already is operating a daily television broadcast schedule with the scanning disc type of transmission.

Pictures 4 x 5 Inches

The pictures formed by the cathode ray receiver are four by five inches in size. They can be made larger or brighter by increasing the voltage used in the receiver. The transmitter of this new television apparatus consists of a motion picture projector rebuilt so that the film to be broadcast passes downward at a constant speed. This film is scanned horizontally by a tiny beam of light which after passing through the film is focussed as a stationary spot on a photo-electric cell. The scanning motion of the beam is produced by a vibrating mirror which deflects the light from one side of the film to the other.

New Cathode Ray Tube

Dr. Zworykin was forced to develop an entirely new type of cathode ray tube for his receiving apparatus which he calls a "kinescope." In this tube a pencil of electrons is bombarding a screen of fluorescent material. The pencil follows the movement of the scanning light beam in the transmitter while its intensity is regulated by the strength of the impulses received from the transmitter. The movement of the scanning beam, consequently of the cathode ray pencil are so rapid that the eye receives a perfect impression of a continuous miniature motion picture. A reflecting mirror mounted on the receiver permits the picture to be observed by a number of spectators.

Saving on Wave Bands

To the radio engineer the invention is important because it will not be wasteful of radio wave bands. This because the transmitter and receiver can be synchronized using but one channel. The name of Dr. Zworykin is not new to the radio public. Earlier this year he was brought into the limelight in connection with his facsimile transmitting device for telegraphing photographs, letters, drawings and documents.

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THE editors of THE MOTION PICTURE PROJECTIONIST solicit your aid to the end that this publication may be of the maximum service to you. Every subscriber can do his bit to improve this service by using the space provided below to indicate his preference for special articles and other material in which he may be particularly interested.

Let us know your preference, please. All requests will receive attention in the order of their receipt, so act quickly. Use the blank below to tell us in just what subject you are particularly interested. Do it now!

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Direct Current Flow

THE traditional error that direct current flows from positive to negative is preserved in standard practice today, because of convenience, and in fact this situation is not fraught with any harm or difficulty, since a great body of technique has been built up on the earlier misassumption, instruments predicated on it and valuable books written on that basis. We must bear in mind, however, that direct current actually always flows from negative to positive, always did and probably always will!

Knowing that, we may proceed to accept the standard practice of rating the current direction as just the opposite, and for the same purpose of convenience split the current into two opposite directions, that is, opposite in point of view, or relatively opposite, although actually the same.

Direction of Current Flow

Nobody would say that the hands of a clock for half a revolution go in one direction and for the other half in the opposite direction, yet if we assigned polarity signs to the points where the diameter meets the circumference we would indeed have to adopt the theory of opposite direction even for the hands of a clock! That would be simply adopting certain signs for reference points, as is done in radio, the signs being positive and negative.

When we consider the source of supply we are really contemplating an elevating device, the object that is elevated being the voltage, and the course of current of a circuit attached to the supply could be considered independent of the source of supply. But it is more usual to regard the current as flowing through the supply, from negative to positive.

Taking this condition, and applying it to a rectifier circuit, as in a B supply, with only a voltage divider as the load, it is plain that current will flow through the divider, and that the direction of flow will be from positive to negative, on the basis of the well-preserved traditional error. The divider is a load on the supply. To account for the presence of the positive voltage at the top the current may be assumed to flow in the supply from negative to positive.

Bleeder Current

Hence we have a complete representation of a circuit, and if we know what is the resistance connected from plus to minus, and the voltage drop across this resistance, hence the potential difference between plus and minus, we can compute the current. If the voltage from (+) to (—) is 300 volts and the resistance of the strip between them is 10,000 ohms, the current is the voltage divided by the resistance, or, 300-10,000, equally .03 ampere, usually mentioned as 30 milliamperes. In a B supply this current flowing independently through the entirety of the resistor is called the bleeder current.

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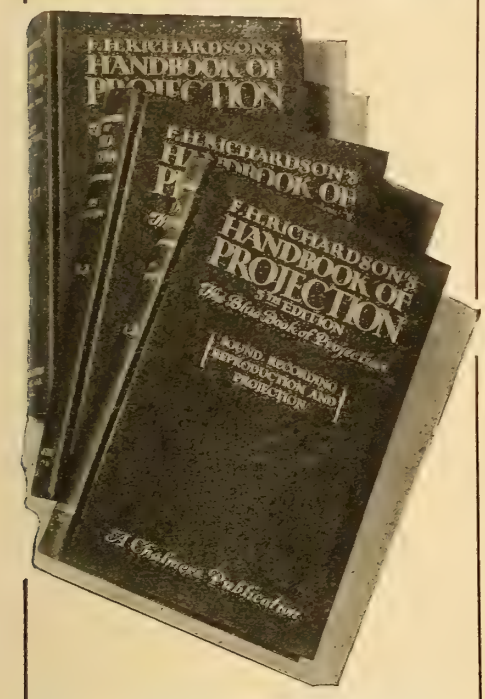
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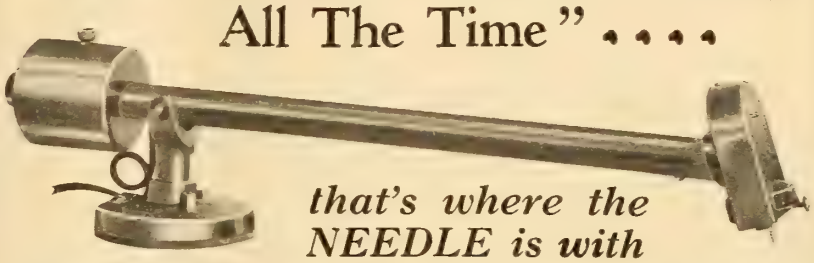
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Carbon Arcs Return to Favor

RECENT large orders for carbon arc equipment placed by Paramount, as well as Fox, give substance to rumors that several large producers, including Fox, are considering adoption of the new silent arcs exclusively in the production of talkies. Fox now has more than a million dollars' worth of lighting equipment of which less than ten thousand dollars' worth is incandescent, while recent purchases of carbon arc exceed $100,000.

Carbon arcs are said to give more definition to the countenance than is possible with hard lighting. Actors also like to work with arcs better because they are free from the excessive heat generated by the big bulbs.

Prize Picture Used Arcs

Another indication that carbon arc lighting has regained its old supremacy is seen in the recent selection of "Street Angel," Wm. Fox Movietone, as the best photographed picture of the year by the Awards Committee of the National Academy of Moving Picture Arts and Sciences.

Controversy over the respective merits of carbon arc and hard lighting has waged ever since the advent of the talkies when arc equipment then in use was considered noisy for talkie production. Perfection of a choke coil that eliminates the commutator ripple, together with extensive experiments in the handling of carbon arcs in talkie production, seems to have turned the tide of battle.

The Wage Drama

Take the willingness to experiment out of life and you soon write "finished" on a nation's, a class' or an individual's tomb. Experimentation is necessary to change, and change is the evidence of vitality. The Great War taught by cruel necessity the need of experimentation. It taught the rich reward of experimentation. It initiated many revolutionary methods in business, but none more revolutionary than the experiment of treating the wage-earner as a consumer.

For years—for 50 years—long before Mr. Ford ever pumped up a bicycle tire, organized labor was saying, "High wage is a guarantee of prosperity. Depressions come because the producer, who is also a consumer, cannot buy back what he produces. Give us high wages and business will be good."

But this plea fell on deaf ears, stony hearts, and ivory heads. At the first sign of bad times, the mill shut down, and the workers, who were also potential buyers, were kicked into the streets. No wonder goods failed to move, and panics came.

It was the need of new markets under the principle and practice of mass production (which demands mass consumption) which brought about a change of business psychology in respect to wages. That change has been everywhere in evidence, but how sincere, profound or widespread it is, remains to be seen.

We shall see, within the next six months, what we shall see. If under the threat of business depression, wages are maintained, and even raised, and business mends rapidly, we may say, that a salutary, sweeping and revolutionry economic change has actually taken place in these United States.—*Electrical Workers' Journal.*

Musicians Can Now Compose on Typewriters

THE task of composing music on a typewriter, often called an impossibility both by musicians and experts on mechanics, is reported to have been accomplished by an Italian musician and mechanician, Signor Andrea Ferretto. Written music is the most complex of all equivalents of language. Not only are there the 90 or 100 notes, each of a distinct pitch, which can be played on some musical instrument, but these notes must be placed in proper positions on the musical staff, each note must indicate its proper length of time, notes must be linked together in threes or other phrases, expression marks must be added, and, what is perhaps the greatest difficulty of all, it must be possible to write series of notes in the different keys of conventional music.

With pen and ruled paper the musician learns to write this complicated language as readily as he uses the 26 letters of the alphabet but no machine previously constructed has had mechanical brains able to do this satisfactorily.

Signor Ferretto's device for which this success is claimed resembles a typewriter to which have been added cams and gears and levers like those of a mechanical calculator. Its 64 keys are like typewriter keys except that they can be locked temporarily when depressed. In addition, levers and knobs control gearing which permits composition in any key. There is even a mechanism similar to that used on linotype machines, by which the line of music can be "justified," so that it ends always with the end of a musical measure.

Chapter 7, A. P. S., Banquet

The first midnight banquet and ball of the California Chapter, American Projection Society, was given at the Roosevelt Hotel, Los Angeles, on November 26th last. President Sidney Burton presided, and was ably assisted by Secretary David Koskoff and Treasurer Edward Keller. One hundred and forty-five guests were in attendance, and the affair was a tremendous success.

New Advances in the Art

(*Continued from page* 39)

for the present screen grid tube. The new five-element tube would have a screen for the grid, as well as the present screen for the plate. The new screen is said to lower the internal resistance, resulting in greater amplification.

Radical Changes Unnecessary

Tube engineers say that the new tube will require no special radio frequency transformers.

In experiments with the new tube, coils designed for general purpose three-element tubes have been found to work efficiently. It has been found that primaries of from 6 to 10 turns gave the rated voltage amplification of 200 per stage. It is expected that the new tube will be easily interchangeable in sets using the present screen-grid tube, as the only requirement will be the wire for the auxiliary grid bias.



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Checking By Meters

So important is the accurate regulation of voltage and amperage, and so harmful can be the effect of a change in these factors as a result of carelessness, that meters are supplied on panels where they can be handy for supervision and watching. They are not there for ornament but for use, and they should be watched closely and their readings be made to correspond—not closely enough to be a fair guess but exactly—with the manufacturers' specifications for operation of the equipment.

Not only can super-voltages heat valve plates and thus quickly ruin the vacuum tubes but they may also damage the wiring and some of the other elements of the assembly, just as high filament current will rapidly dissipate the electrons of filament composition without doing additional useful work. Meters themselves should be, and probably are, carefully checked at regular intervals by service men.

Meters are of two kinds: one registering voltage or pressure, and one registering current flow or amperage. Their names show their use, as, for example, *voltmeter* and *ammeter*. Often their scales are combined upon one dial or instrument, and in such a case care must be exercised in understanding which is which and what each registers. Wiring diagrams are very essential to a proper understanding of the functioning of meters.

Meter Calibrations

Meters are often calibrated, that is, scaled for subdivisions of volts or amperes, because in some circuits of the apparatus these smaller amounts of electrical energy are sufficient, and their control may be of extreme importance. Therefore, especially for amperage, the calibration may be for milliamperes instead of for amperes. Care must be exercised so that there may be no misunderstanding of the differences and not mistake amperage calibration for its much less consuming milliampere marking. Otherwise—hot wires, poor functioning, burned-out wiring, perhaps even a fire, if the super-amperage be accidentally left unguarded.

Methods of Control

Wherever there is a meter it is in circuit with some means for controlling and regulating the current from which its reading is taken. In some instances this control is by variable resistance, or moving-arm rheostat, or by potentiometer which, in some cases, serves to shunt off a certain portion of the full current while the balance is sent on, either at full power or with a drop through a suitable resistance.

In this connection it may be well to emphasize for the sake of clarity the fact that when a knob or dial is marked "volume control" or any similar description of the result, it does not refer to the actual function but rather to the result in the loudspeakers, because in reality it is the factors governing volume which are controlled by the knob. The actual control may be an influence on the potential of the plate circuit of the amplifier stages, or it may be a partial shunting of the delivered result.

Filament heating is not so much used to control volume or intensity of output as formerly, because changing the heat degrees of a filament, while it raises the emission of electrons, may not contribute a correct increase of flow to the plate unless the potential of the plate is also altered to accommodate new conditions. Filament control is intended primarily to keep filament current within the best operating range for that particular value or series of coupled or intercircuited valves, to act as a check on over-heating, waste, and life-shortening, rather than as a means of securing additional volume.

Coast S. M. P. E. to Study Latest Developments

The Pacific Coast Section of the Society of Motion Picture Engineers has planned an ambitious program of ten meetings to be held during the coming year to study the latest developments in the industry. The subjects of the meetings and number of meetings on each subject follow: color, 3; wide film, 2; laboratory procedure, 3; stereoscopic depth, 1, and television 1.

Speakers who are authorities on the various subjects are being obtained to address the meetings. It is planned to have two papers read at each meeting, followed by general discussion. The first of the series of meetings was held December 5, at the California Institute of Technology in Pasadena, when Dr. Walter T. Whitney, Associate Professor of Astronomy, Pomona College, lectured on "Light and Color."

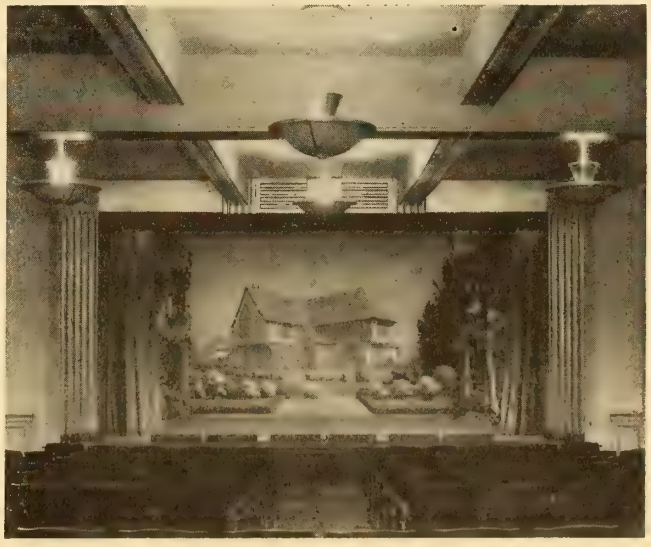
At present the membership of the Pacific Coast Section numbers approximately seventy-five.

Care of Electrical Machinery

All electrical machinery not especially constructed to resist injury by moisture should be kept dry. If a machine has been exposed to moisture, the windings should be thoroughly dried before the machine is placed in service. Small machines can be baked in ovens and larger units can be dried by passing current through the windings. In either case, however, the temperature should be kept within a maximum of 85 degree C. The temperature should be raised gradually and should be kept as nearly uniform as possible throughout the windings. The drying out process should be continued until the insulation resistance becomes constant.

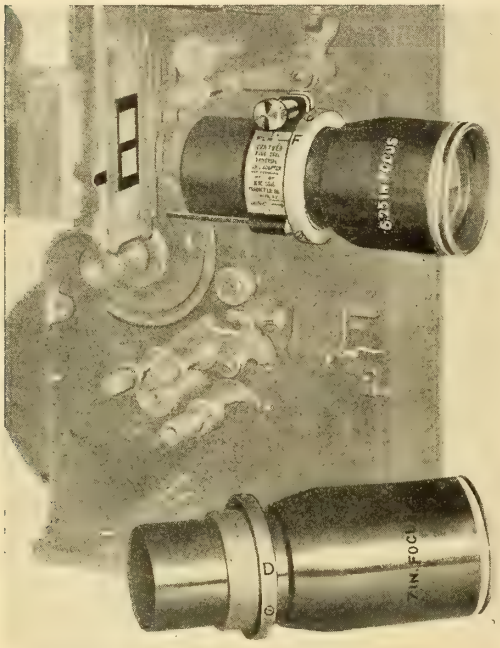
The insulation resistance of large machines or machines known to have been subjected to moisture should be tested before they are operated, to determine whether the insulation of the machine has been mechanically injured or damaged by moisture after the factory test and since the machine left the factory.

The higher the resistance, the better the general condition of the insulation material, although the insulation resistance of electrical machinery is not of so much significance as the dielectric strength. The insulation resistance varies greatly with temperature, humidity and the cleanliness of the parts. When the insulation resistance falls below the limit as determined by the foregoing formula, it can, in most cases of good design and where no defects exist, be brought up to the required standard by cleaning and drying the machine. The insulation resistance may, therefore, afford a useful indication as to whether the machine is in suitable condition for application of voltage.



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Standard Nomenclature

(*Continued from page* 41)

rendered developable by the action of light.

SENSIOMETRY — (photographic) — The science of analyzing the response of photographic materials to radiation. The term "sensiometry" as commonly used in the motion picture industry refers to photographic sensiometry. The word itself, of course, means the measurement of sensitivity and hence may be applied to other things than photographic materials. For instance, visual sensiometry refers to the measurement of the various responses of the eye to radiant energy.

SHADOW SCRATCH—See Optical Scratch.

SHARPNESS—The rate of change of density with distance from the edge of a photographic image.

SHUTTER—A moving element, usually rotating, which intercepts the beam of light in a motion picture camera, projector or printer, one or more times during each cycle.

SINGLE PICTURE CRANK—(sometimes referred to as trick spindle)—A crank on a motion picture camera which makes one exposure at each complete revolution.

SLIT—The mechanical slit, a part of the optical system, the image of which is focused on the film.

SLIT IMAGE—The image of the slit produced by the objective lens of the optical system.

SOUND ATTACHMENT—Any mechanism designed as an attachment to standard projectors to permit reproduction of synchronized sounds and picture.

SOUND GATE—A gate similar to that used in picture projectors through which the film is pulled past the reproducing light beam in gate-type machines.

SOUND HEAD—Compartment on the projector which contains sound reproducing systems and mechanism for guiding and driving film.

SOUND NEGATIVE — Negative on which sound track only is recorded.

SOUND OVERSHOOTING—As applied to variable area recording, this refers to the condition where the peaks along the sound track extend beyond the limits of the track and are accordingly cut off during reproduction, resulting in deterioration of quality. As applied to variable density recording, it applies to areas of sound track of excessive or incorrect opacity and has a similar result.

SOUND PICK-UP—Device or system for reproducing sound from film or disc. In sound-on-film, the sound pick-up is an optical-electrical system contained in a compartment on the projector. In sound-on-disc, the pick-up is an electro-magnetic device which transforms the physical variations in the grooves of the disc into electrical variations.

SOUND RECORDER—An optical-electrical mechanical system for changing electrical impulses, generated by sound striking a microphone, into corresponding light variations that are photographed on the film or into mechanical vibrations which are recorded on a wax disc.

SPECTOGRAM—A photographic representation showing the distribution of energy in the spectrum. These are most commonly used to show graphically the spectral distribution of energy and the radiation from a light source, the spectral distribution of energy transmitted by or reflected from selectively absorbing materials, and the spectral distribution of the sensitivity of photographic materials.

SPECTROPHOTOMETRY—The science of measuring the distribution of energy at various wave-lengths.

SPECULAR DENSITY—The value of density in which the specular component of transmitted intensity is measured. (This value of density is applicable to projection printing and projection in general).

STRING GALVANOMETER—A device used in photographic sound recording consisting of a conducting wire or ribbon in a strong magnetic field.

SUBSTANDARD FILM — Film whose width is less than the normal 35 mm.

SUBTRACTIVE PROCESS—Color processes in which various hues are obtained by absorption in varying degree of one or more of the spectral regions comprising white light.

T

TONING—Coloring a film by chemical action on the silver image.

TRANSMISSION UNIT—See "Bel."

TRICK PICTURE—A motion picture intended to give the effect of action other than that which actually took place, or to give the impression that the action took place under circumstances other than those which actually prevailed.

U

UNMODULATED DENSITY—In sound-on-film processes, the density of the developed sound track obtained with the exciting lamp glowing but with its output modulated by sound.

V

VARIABLE AREA SOUND TRACK—The type of sound track in which the sound is represented by the irregularity of a boundary line running, in a general way, parallel to the sides of the sound track and dividing it into opaque and transparent areas.

VARIABLE DENSITY SOUND TRACK—The type of sound track in which the sound is represented by parallel lines of varying density of opacity perpendicular to the edge of the sound track and extending across its full width.

VISION—A new subject introduced into the main picture, by the gradual fading-in and fading-out of the new subject, as, for example, the visualization of a thought.

VOLT—The unit of measure of an electro-motive force, potential, or electrical pressure in a circuit.

VOLUME CONTROL—A variable resistance or other circuit arrangement in the vacuum tube amplifier circuits employed to control the loudness of the reproduced sound coming from the loudspeakers.

W

WATT—The unit of quantity of electrical power.

WAVE LENGTH—In any wave motion, the distance between any two points in the same phase in adjoining waves, e.g., the distance from the crest to crest.

WAX—A soapy-metallic disc, one to two inches thick, on which the first impression of sound in the sound-on-disc process is cut.

WORKING DISTANCE—The distance between an object and the nearest face of a lens forming an image of the object.

WOW WOWS—Change in pitch of the reproduced sound caused by sound film speed fluctuation in either recording or reproducing process. Also known as "flutter."

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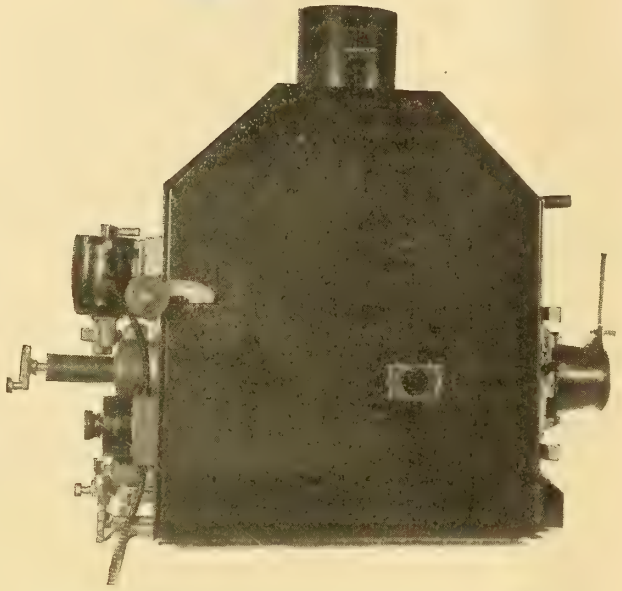
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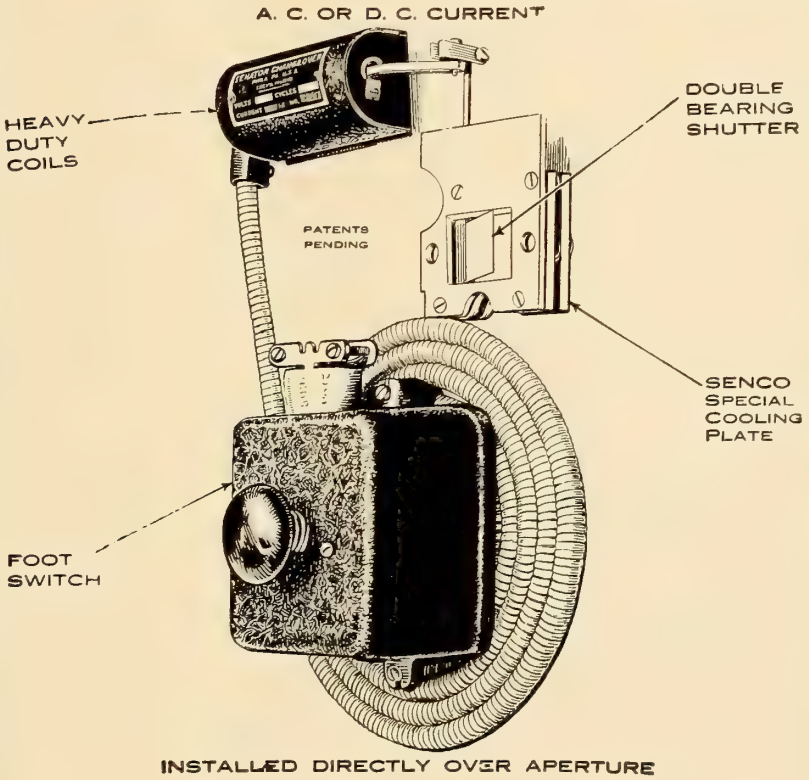
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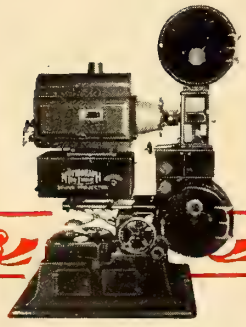
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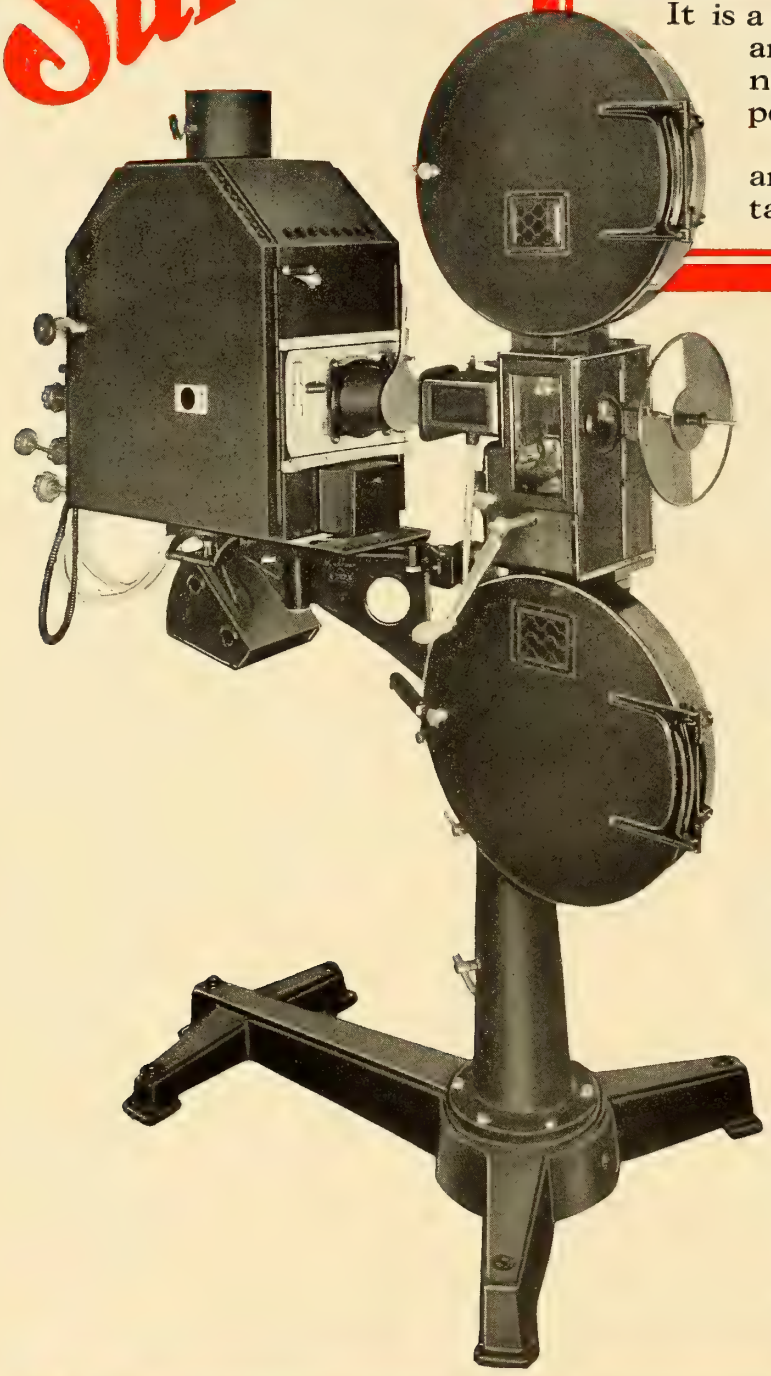
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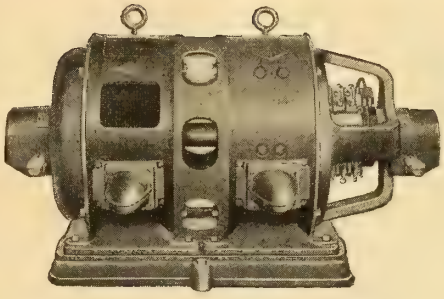
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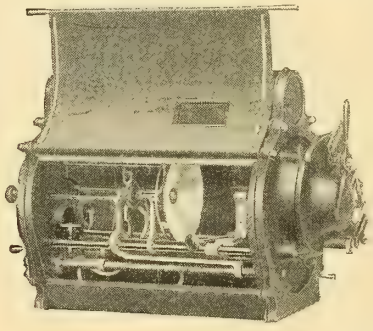
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M. P. Academy to Sponsor Technical Standards

TECHNICAL activities effecting the production branch of the motion picture industry will be centralized through the Academy of Motion Picture Arts and Sciences, it was announced recently, with the transfer to the Academy of the technical bureau which for the past two years has been maintained by the Association of Motion Picture Producers. The facilities of the Academy will be continued and expanded as a clearing house for technical data and as the medium of cooperative research of non-competitive problems among the studios.

A research laboratory is now contemplated in the Academy's plans, which will emphasize correlation of the work of the various present laboratories for maximum efficiency on problems facing the industry generally or common to a number of studios. Standardization of materials and non-competitive processes will be furthered and the studios will be kept in direct touch with technical improvements effecting the industry.

Projection Standards

Camera and projector apertures were recently standardized through the Academy. Specifications will be announced in the near future for the standardization of the positive prints used by theatres. The school in Fundamentals of Sound Recording and Reproduction for Motion Pictures recently conducted for employees of 17 studios will be continued and similar educational projects undertaken for other branches of the industry. Composed of 400 of the principal motion picture actors, directors, producers, technicians and writers, the Academy is a non-profit service organization.



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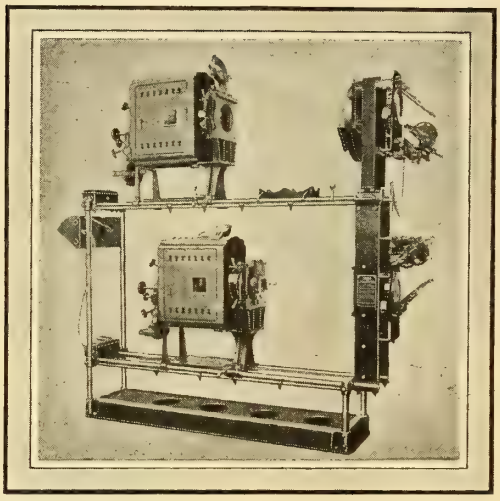
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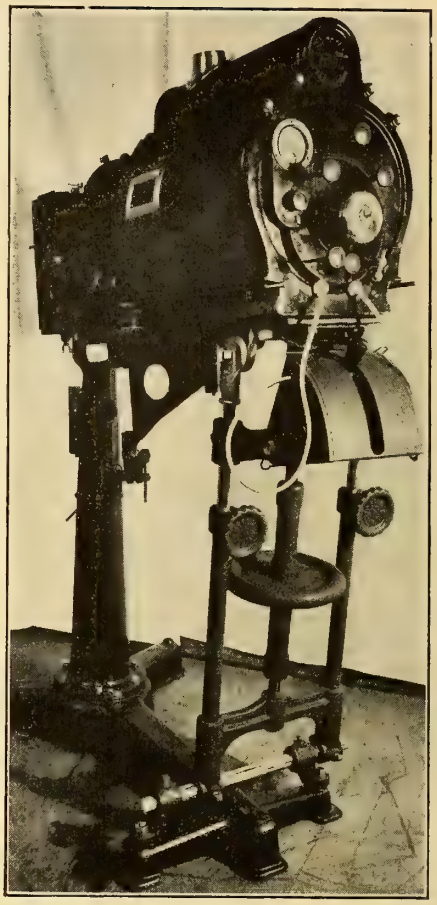
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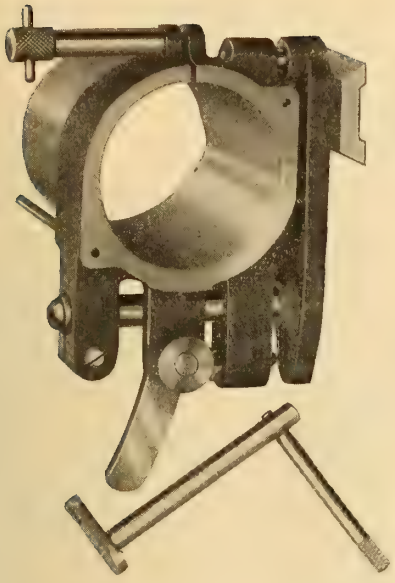
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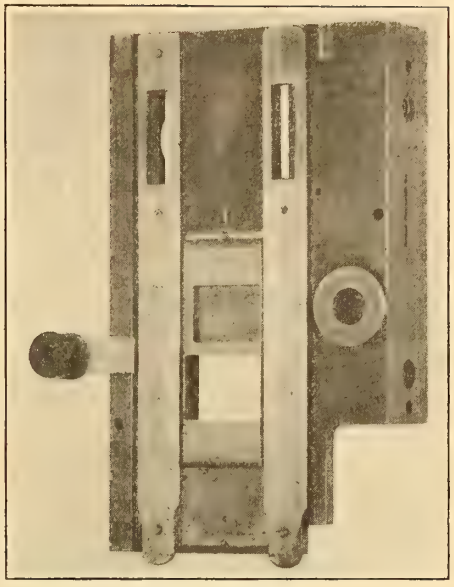
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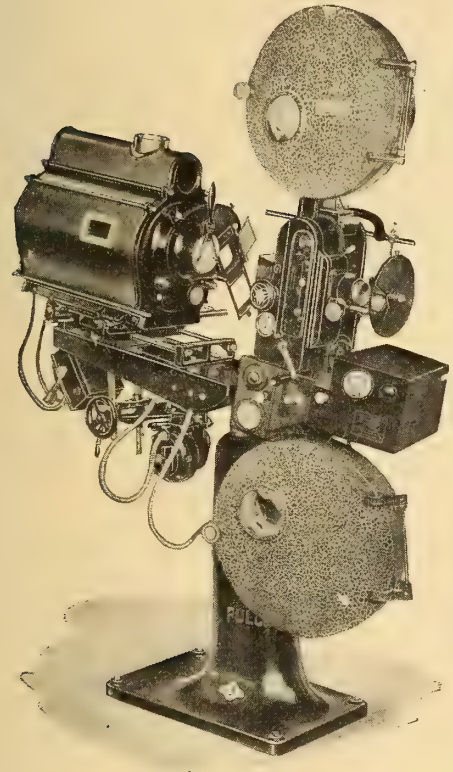
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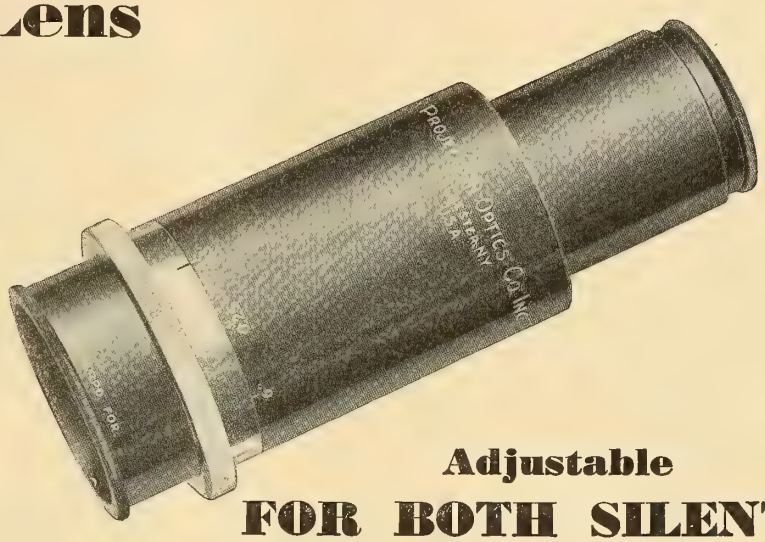
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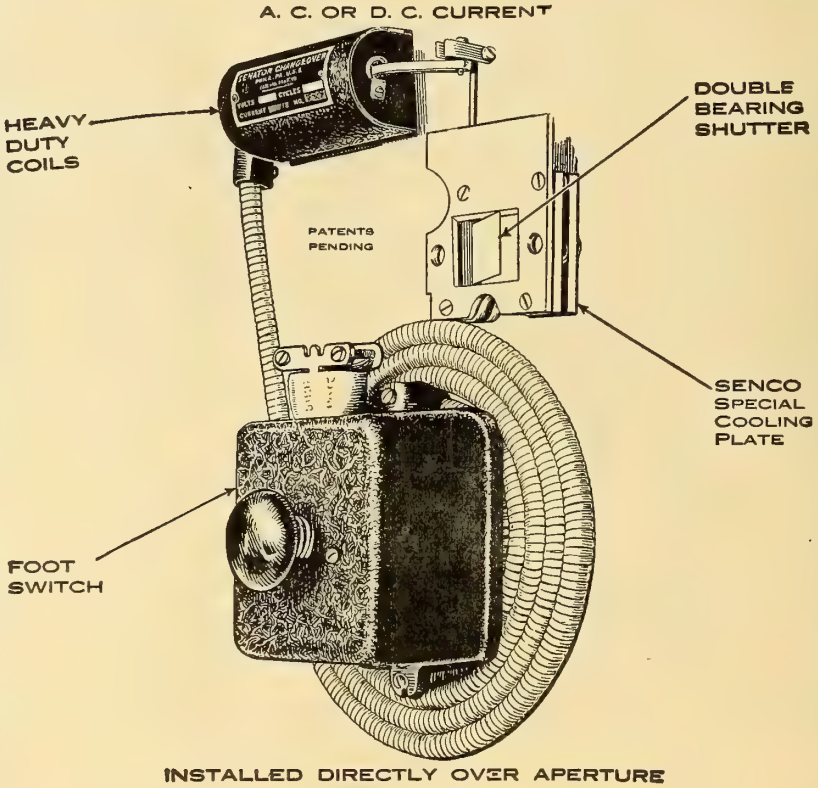
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Inductive and Capacitive Reactance

By J. E. ANDERSON*

THE present interest in non-reactive, direct-coupled amplifiers has brought up the question as to when a circuit is reactive and when non-reactive. We shall try to explain under what conditions a circuit is non-reactive, that is to say, when it has no reactance. There are two types of reactance, inductive and capacitive. Inductive reactance is akin to inertia reactance and is due to electrical inertia. Capacitive reactance is akin to compressive reactance or elastic reactance and is due to electric elasticity.

These statements are scarcely explanatory since the analogous concepts may not be any better understood by some than the electrical concepts. But let us try to expand on these statements.

Inertia is that property of a massive body by which that body tends to remain in its present state of motion or immobility when acted on by a force of any kind. Consider, for example, a person riding on a train. The person has mass and therefore inertia. When the train is at rest the person also is at rest and tends to remain in that state of immobility. If the train suddenly starts the person tends to remain stationary and therefore will tend to fall in the direction opposite to that in which the train started.

Now suppose the train has been speeding at a constant rate for some time. The person has been moving at the same speed. But if the train should suddenly stop the person moves forward in the direction he was going. The inertia tends to keep him going with the same speed and only force can prevent him from continuing. Sometimes this force may be fatal to the person.

Resists Change of Velocity

Inertia does not enter only when the train starts and stops but whenever there is any change in the speed of the train or in the direction in which the train travels. For example, whenever the train slows down the person lurches forward, and whenever the train accelerates he lurches backward. Likewise when the direction of the train changes one way or the other the person lurches sidewise in the direction opposite to the new direction of the train. In every case the person tends to remain in his original state of motion or immobility. This statement includes changes of direction as well as absolute motion.

What is true of a person is true of every other body, living or dead, that has mass or that weighs something when put on a balance.

Inductance in electricity is analogous to mass in mechanics, and electric current is analogous to velocity. If there is inductance in a circuit it requires a force, or electromotive force, to start or stop a current in that circuit. It also requires an electromotive force to change the direction, or the intensity, of the current. The greater the inductance (electric mass), the greater the electromotive force required to produce a given change in the intensity of the current.

If the electromotive force is alternating rapidly, that is, acting first in one direction and then in the other, and there is an inductance in the circuit, the intensity of the alternating current resulting will be small because of the electric inertia. The larger the inductance the smaller the current.

The Mechanical Analogy

We might take a mechanical analogy for illustration of this effect. Suppose we take a heavy ball or other body and swing it back and forth. The force exerted by the hand in swinging the body corresponds to the alternating electromotive force and the resulting motion of the body corresponds to the electric current. The heavier the body, that is, the more massive, the more difficult it is to swing the weight. If an attempt be made to swing the weight rapidly to and fro, a distinct reaction is felt, and the reaction is the greater the more rapidly it is attempted to shake the weight or the greater the weight. The rapidity with which the weight is shaken corresponds to the frequency of the electrical current.

Elastic Reactance

Capacitive reactance was likened to elastic reactance. Elasticity is the property of a body by which it resists changes in shape or volume provided that after the body has been deformed by a force it returns to its original shape or volume after the deforming force has been removed. A well known example of an elastic body is a rubber band. It may be stretched to several times its normal length by exerting a force, and when the force is removed it returns to its normal length. A steel wire helix is another well known elastic body. If the turns of the helix are close, the spring may be stretched and it will return to its normal form as soon as the stretching force is removed. If the spring is not wound closely, it may also be compressed, and after the compressing force has been removed the spring will lengthen to its normal length.

Even a straight steel wire may be stretched by exerting a force, and as soon as the force is removed the wire will assume its original length, provided that the stretching has not been overdone. Steel and other elastic substances also resist bending, twisting, and compression. When one of these bodies has been deformed by force in any one of these ways, within limits, it will return to its original shape or volume after the deforming force has been removed.

Electric Analogy

Gases are well known examples of substances which resist change of volume. It takes force to put more air for example, into a confined space, such as an automobile tire. After the compression has taken place and the compression force is removed, the excess gas in the confined space will immediately escape so that afterwards the gas occupies the same volume as it originally did.

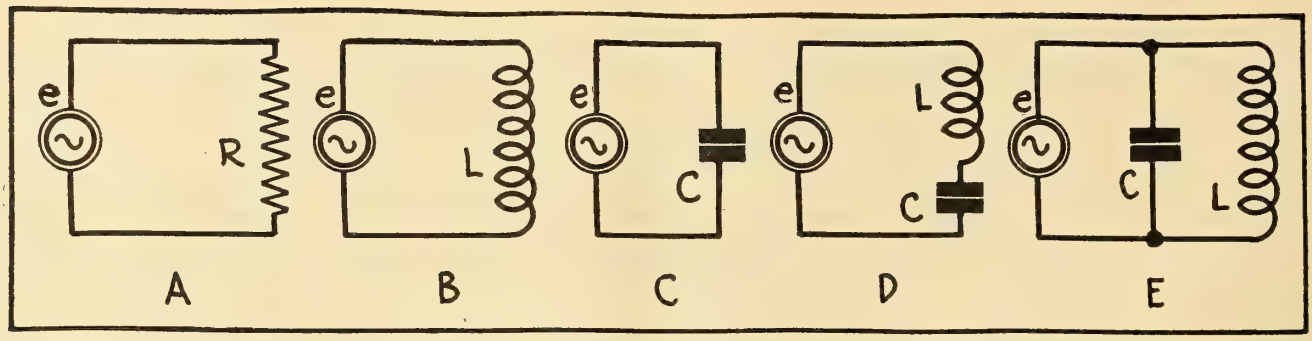
An electric condenser is a device into which electricity may be forced or compressed. It is a sort of vessel for storing electricity, but electric charge has the property of elasticity. It requires an electric force to charge a condenser or to force more electricity into it than would normally be contained therein if there were no electric force. The amount that can be forced into the condenser depends directly on the intensity of the force, that is voltage, and on the capacity of the condenser, its electric dimensions.

One who has pumped up an automobile tire by hand will know that at the beginning the work is easy. There is very little reactance. But as the pumping proceeds and the pressure increases in the tire, more force is required at each stroke. The amount of air that can be pumped in depends on the volume of the tire and on the force that is exerted. The analogy between the pneumatic and the electrical cases is very close. If electricity is regarded as a gas the two become practically identical.

Further Similarity

Suppose air has been pumped into a bottle and the cork is suddenly removed. There is a pop which has a more or less definite pitch. That is, a sound of a certain frequency is produced a short period. This would not be possible were not the air also possessed of inertia or mass. The air rushes out when the cork is first pulled out. The inertia of the moving air keeps the air flowing after the pres-

*Technical editor, *Radio World*.



Five different simple circuits. A—non-reactive; B—Having inductive reactance; C—capacitive reactance; D—both inductive and capacitive reactance with the coil and condenser in series; and E—both types of reactance but in which condenser and coil are connected in parallel

sures inside and outside have become equalized. It keeps flowing outward until the pressure inside is less than the pressure outside. Then it begins to rush in again. This inward and outward motion of air keeps up for a moment, giving rise to the musical quality of the pop. This oscillation is only possible because the air possesses both elasticity and inertia.

An electrical circuit comprising capacity and inductance behaves in the same way. The current rushes in and out of the condenser for a moment after the first discharge and it keeps up for a time depending on the amount of resistance in the circuit. The greater the resistance the shorter the time of oscillation.

Simple Circuits

In the accompanying figure are five different simple electrical circuits. In each there is a source of alternating electromotive force *E*. This electromotive force drives a current through each circuit, but in each case the current has a different intensity because the reactances of the circuit are different.

In *A* we have a non-reactive circuit because there is only a pure resistance in series with the electromotive force. There is no reactance in the circuit since there is neither inductance (inertia), or capacity (elasticity). The energy is all dissipated in the resistance R and for that reason a non-reactive circuit is called a dissipative circuit.

In *B* we have an inductance in series with the electromotive force. This circuit has inertia reactance, the coil resists any changes in intensity or direction of current. For this reason the current will be small and it will be smaller the higher the frequency and the higher the inductance. It is the fact that the current is dependent on the frequency, which makes reactive circuits undesirable in audio frequency amplifiers.

In *C* we have a simple reactive circuit comprising a condenser in series with the electromotive force. Since there is elastic reactance in this circuit the current will depend on the intensity and frequency of the alternating electromotive force. The larger the condenser the larger the current will be and also the higher the frequency the higher the current. Direct current will not flow at all and currents of very high frequency will flow just as if the condenser were not in the circuit. Since the current depends on the frequency a circuit having condensive, or elastic reactance, is not desirable in an audio frequency amplifier.

Mixed Circuits

The circuit in *D* contains both capacity and inductance in series with the electromotive force. What the current will be in this circuit depends on the frequency, the inductance and the capacity. For low frequencies the current will be mainly determined by the condenser, since the coil will not offer much reactance compared with the reactance of the condenser. At high frequencies the current will be mainly determined by the inductance, since the condenser will offer very little reactance.

When the frequency is such that the inductive reactance is equal to the capacitive reactance, resonance will obtain and the current will be determined by the electromotive force and any resistance which may exist in the circuit, especially in the coil. As resonance the circuit is non-reactive and dissipative. The current will be very large in comparison with the current at frequencies off resonance.

Parallel Resonance

The circuit in *E* is known as the parallel tuned circuit when the capacity and the inductance are so related to the frequency of the electromotive force than the inductive reactance is equal to the capacitive reactance. When this condition obtains the current through the source of electromotive force is zero or minimum and the current in the condenser and the coil maximum. The impedance presented by the condenser and the coil to the source of electromotive force is a pure resistance of exceedingly high value. The voltage across either the condenser or the coil is very high.

The reason the currents in the coil and the condenser can be very large and the current in the source of electromotive force very small is that the currents in the coil and the condenser are out of phase. They neutralize each other as far as the current through the generator is concerned.

Examples of Reactances

In audio frequency amplifiers there should not be any reactances of either kind, because any reactance will introduce frequency discrimination which will mar the quality. Yet in nearly all cases some reactances must be used to make the circuits practical.

There should, for example, be a small by-pass condenser in the plate circuit of the detector. This lowers the output at the high audio frequencies to some extent. Then in many circuits stopping condensers are used between the plate of one tube and the grid of the next, or between the plate of the power tube and the loudspeaker. These condensers lower the output of the low frequencies. The smaller these condensers, the more do they suppress the low notes. In some circuits now being popularized most of the stopping condensers are eliminated with considerable gain of the low note output.

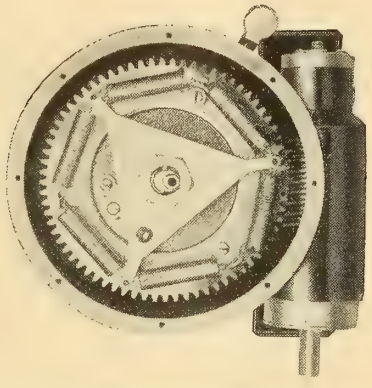
When choke coils and transformers are used for coupling, additional reactances are introduced into the amplifier, both inductive and capacitive, the capacitive reactances being due to stray capacities across the windings. The coupling reactances discriminate against the low notes and the distributive capacity reactances against the high.

Even in the so-called non-reactive circuits by-pass condensers should be used for best results, but these introduce reactance which is discriminatory to some extent. But it is better to use them and suffer the discrimination than to omit them and have a circuit that does not amplify well. It is well to remember then the larger any condenser the lower is its reactance.

The condensers and chokes in the B supply have reactance and consequently affect the frequency characteristics of any amplifier connected to it. These reactances have much to do with the frequency at which a circuit "motorboats" or at which it blasts in case the feedback is not sufficient to sustain oscillation.

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The Three-Element Vacuum Tube

By EDWARD W. KELLOGG*

THE foregoing discussion[1] concerns distortion as affected by the magnitude of the voltage changes impressed on the grid of the first tube. The second requirement for freedom from distortion is that the ratio of amplification shall be independent of the *rapidity* of the voltage changes applied to the first grid. This factor is most readily studied both theoretically and experimentally by means of sine waves of voltage. The rapidity of changes is then expressed in terms of the frequency of the supplied voltage, or number of cycles per second. From this standpoint, the amplifier, if it is to be free from distortion, must give the same amplification of a sine wave voltage whether the frequency be low or high.

Fortunately again, the necessary range for practically perfect amplification as judged by the ear has limits and within these limits absolute constancy is not vital. Amplifiers in general give a maximum amplification throughout a certain range, and for frequencies higher or lower than this middle range the amplification tends to become less. We would regard as practically perfect an amplifier which gives 80 per cent of its maximum amplification at 30 cycles and at 8,000 cycles, and such an amplifier is by no means difficult to construct. Many of the audio frequency amplifiers used for broadcast reception would show less than half of their maximum amplification at 100 cycles and at 4,000 cycles.

Resistance—Capacity Coupling

Fig. 6 shows characteristics of several amplifiers. The resistance-capacity coupled amplifier is most readily analyzed. It is also the type most easily designed to give high quality. The characteristic of a condenser is that it permits high frequency currents to flow readily, but offers a higher and higher impedance to the flow of current as the frequency is lowered. The droop at the low frequency end of a resistance-capacity coupled amplifier is due to the high impedance of the capacity C for low frequency currents.

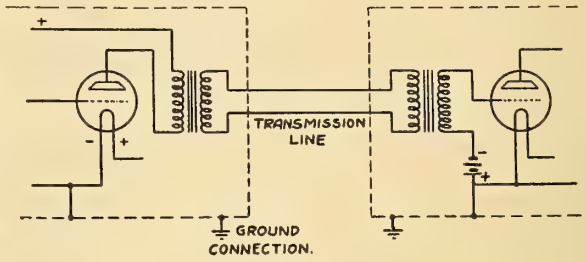


Fig. 7. Connection between two amplifiers by means of insulated transmission line

The total alternating voltage at the plate of tube No. 1 in Fig. 2 is impressed across a condenser and resistance in series. For all frequencies above a certain value the condenser offers a negligible impedance compared with the grid leak resistance R_2 and therefore affects the grid. A frequency so low that the impedance of the condenser becomes equal to that of the resistance will only be amplified to about 70 per cent of the full ratio to which higher frequencies are amplified. Since the grid leak can ordinarily be of the order of 1 or 2 megohms (million ohms), a large condenser is not needed to maintain practically full amplification down to 30 cycles.

The loss of amplification at the high frequency end of the scale is due to the effect of capacities in the wiring and tubes themselves which constitute a load. In other words, the capacity to filament and ground, of the grid of tube No. 2, and the capacity between grid and plate of tube No. 2, constitute by-passes for the high frequency current supplied from the plate of tube No. 1, thus preventing full voltage from being developed between the filament and plate of tube No. 2.

Fictitious Capacity

One factor greatly augments this effect, particularly where tubes of high amplification factor are used. The change of plate potential is opposite to the change of grid potential. For example, if we change the grid by one volt in the positive direction the plate voltage of the same tube changes in the negative direction, or to a lower plus voltage. A charging current flows to the grid as a result of this change in plate potential, in addition to that resulting from the change of grid potential itself, and the effect practically the same as if the plate were held at constant potential but the capacity between plate and grid increased in about the ratio of amplification of the tube.

The effect of this fictitious capacity must be taken into account in all calculations of amplification at high frequency.

Transformer Coupling

Transformer coupled amplifiers have as a class been greatly inferior to resistance-capacity coupled amplifiers. In the transformer coupled amplifier the droop at the high frequency end of the scale is due to the same causes as have just been mentioned, but if the transformer works with a step-up voltage ratio, the effect of capacities across the secondary is greatly increased. For example, with a three to one step-up ratio a given capacity constitutes nine times the load which it would if connected directly from the plate of the preceding tube to ground or filament. Moreover, resonance often occurs owing to the inductance of the transformer windings and this resonance causes a sharp peak in the amplification characteristic, as illustrated in Fig. 6. The bulk of the transformer also tends to add to the inevitable capacities of the wiring system.

At the low frequency end of the scale the transformer causes loss of amplification because the output current which the preceding tube can supply is used up in establishing the necessary magnetic changes in the transformer core, or, in other words,

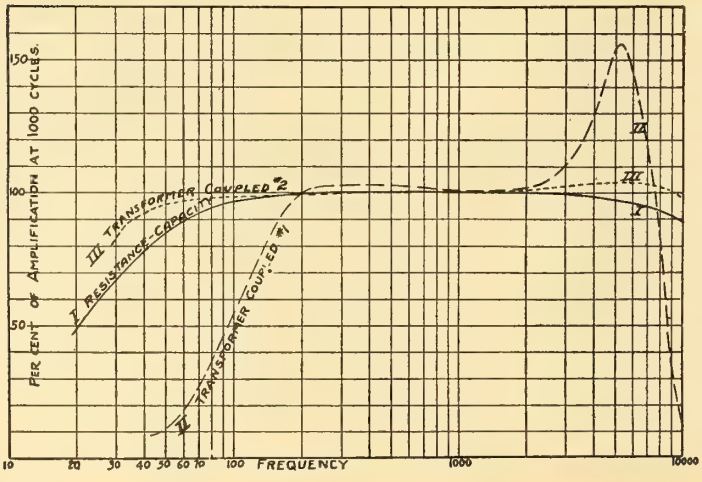


Fig. 6. Examples of amplifier characteristics. I. Six stages resistance coupled; II. Two stages transformer coupled. III. Three stage amplifier used in broadcasting studio

* S. M. P. E. Trans., Vol. XII, No. 36.
[1] Continued from Jan. issue.

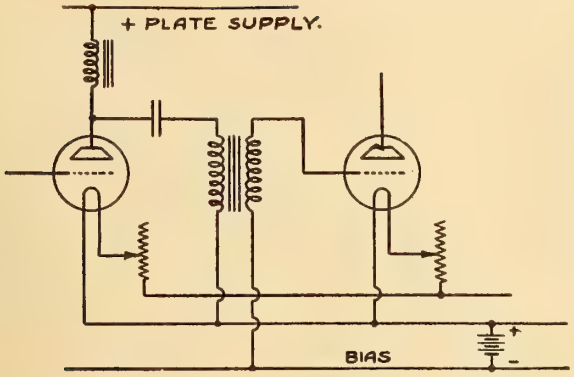


Fig. 8. Transformer coupling with choke coil plate feed

the transformer magnetizing current loads down the tube. The higher the frequency the smaller is the magnetizing current required to produce a given secondary voltage. Hence the transformer magnetizing current is a factor only at the low frequency end of the scale.

The requirement for amplification independent of frequency is that the tube plate must work into what is practically an open circuit, or else into a pure resistance load. So long as the capacity loads at high frequency are negligibly small and the transformer magnetizing current load is small, the amplifications will be nearly constant. In judging whether these loads are sufficiently small to be harmless we must compare them with the internal plate resistance of the tube. The impedance of the capacity loads must be large compared with the tube plate resistance. Likewise the impedance of the primary transformer winding must be high compared with the plate resistance. At such a low frequency impedance becomes equal to the tube plate resistance the amplification will be down to 70 per cent of maximum or less.

RECENTLY new magnetic materials, alloys of nickel and iron, have become available for transformer cores. One of these is known as "permalloy." These can be magnetized with much smaller current than required for the best transformer steels previously available. The use of this high permeability core material together with the practice of not attempting excessive step-up ratios has made it possible to design transformers of such excellent characteristics that they are being used in many places where formerly only resistance capacity couplings could be considered.

The transformer is especially useful when it is desired to connect together amplifiers located in different places. This is done as shown in Fig. 7. An insulated transmission line connected at both ends to a transformer, serves to transmit the output of the first amplifier to the input terminals of the second. Such a balanced and insulated loop is far less subject to picking up induction than the circuit which would be required without the transformers; for example, merely providing a long wire between the plate of one tube and the grid of the next.

In order that electrostatic disturbances shall be minimized it is essential in practically all amplifier work to completely inclose the amplifiers and many of their connecting leads in metal containers; these containers or shields being in general connected together and connected to one of the filament wires of the amplifiers. Where transformer or choke coils are used, it is further necessary to make sure that they are not close to sources of magnetic disturbances such as electric motors.

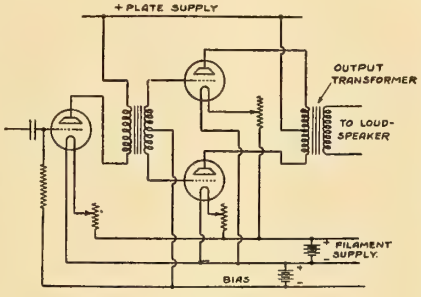


Fig. 9. Push-pull stage of amplifier

Impedance Coupling

A modification of the resistance-capacity coupled amplifier of Fig. 2 is what is commonly called "impedance coupled." The arrangement is the same, except that a choke coil is substituted for the plate feed resistance R_1. The choke coil, like the transformer, must have a high impedance compared with the internal resistance of the tube down to the lowest important frequency to be amplified. This requirement is easier to fulfill in the case of the choke than in that of the transformer, since there are fewer factors to be considered in the design of the choke, and a much larger number of turns can be used without prejudicial results.

The advantage of the choke as compared with the resistance for plate feed is that it does not throw away so much of the supplied voltage; the choke having the characteristic of low resistance for steady current, but high effective resistance or impedance to rapid fluctuations of current. Its disadvantage is that it is in general bulkier than a resistance, and that it may pick up magnetic induction.

It is not uncommon to have the earlier stages of an amplifier resistance coupled, and the final stage or stages impedance- or transformer-coupled. This gives the final tubes the benefit of the full voltage of the supply. The earlier tubes which handle only small voltage swings do not need such high plate voltages. It is sometimes found desirable to employ both a choke coil and a transformer with a condenser between, as shown in Fig. 8. The purpose of this is to eliminate the steady current from the transformer winding, which is especially important when a permalloy core is used. Such a combination can be designed to maintain full amplification down to a low frequency or even give a low frequency peak if desired, while below this frequency it cuts off much more sharply than a simple resistance-capacity or transformer coupling.

It is in general not desirable to extend the range of an amplifier beyond the frequency range which is acoustically useful, since such extension increases the likelihood of feedback and consequent parasitic oscillations, which, while generally curable, are often very troublesome.

Push-Pull Connection

Fig. 9 shows what is known as the push pull connection which is frequently used for the final stage of amplifiers. In this arrangement some of the distortion resulting from curvature in the characteristics of the tubes is neutralized.

Fig. 10 shows the usual method of

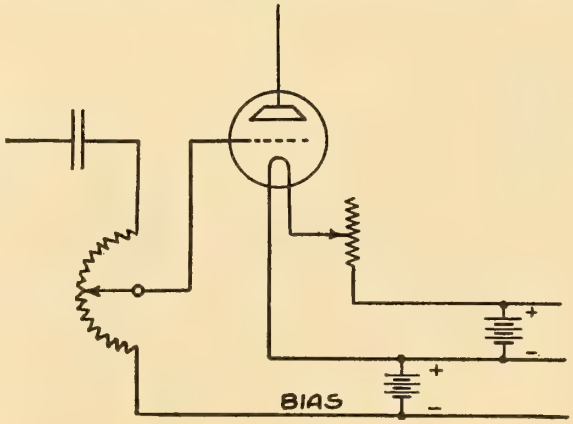


Fig. 10. Grid potentiometer for volume control

controlling loudness. The voltage applied to the grid is equal to that at the plate of the preceding tube, multiplied by the fraction of the total resistance included between the sliding contact, and the steady potential end, which is shown connected to the biasing battery.

Tubes used with transformer coupled amplifiers usually have amplification factors of six to eight and plate resistances of 10,000 to 20,000 ohms. Tubes intended for resistance-capacity coupled amplifiers have amplification factors of 20 to 30 and plate resistances of 50,000 to 100,000 ohms. Voltage applications of 20 to 25 per stage over the audio range is common. Tubes intended for the output stages, or "power tubes" generally, have amplification factors of only 3 or 4, and plate resistances ranging from 2,000 to 6,000 ohms. The more common power tubes range from a receiving set tube operating from a 135-volt battery, with a possible undistorted output of 0.1 watt, to a tube whose plate circuit requires 0.1 ampere at 1,000 volts, and which can give an undistorted output of about 20 watts.

Discussion:

Mr. Pieri: In view of the important part that vacuum tube amplifiers play in recording and reproducing sound motion pictures, would you mind tracing through the circuit and telling us in layman's language exactly what takes place and what happens when overloading takes place?

Mr. Kellogg: Suppose the grid in Fig. 1[a] is at a bias of 5 volts and the plate is at 100 volts. That combination of potentials results in a certain field between filament and grid, and a current of, say, 3 milliamperes flows to the plate. Now if the grid potential is changed suddenly from 5 to 4, an increase in plate current results, and that in turn causes a decrease in plate voltage, because with, say, 4 milliamperes flowing from the battery to the plate instead of 3 there is a greater voltage drop through the resistance. The plate voltage might change from 100 to perhaps 90 volts, depending on the value of the resistance. This would mean a voltage amplification of 5. Does that answer your question?

Mr. Pieri: I thought it might be wise to go into this. Also, by turning up the gain too much, why is there this distortion?

Mr. Kellogg: Referring to Fig. 4[b], suppose curves 111 and 111-A represent the characteristics of a later stage of the amplifier, not necessarily the output or power stage but a tube that must swing 20 or 30 volts on the plate. Suppose that the tube has been working with 4.5 volts bias on the grid. If the grid voltage only swings 1.5 volts each way, or between 3 and 6 volts, you are working over the straight part of this characteristic.

Now you turn up the gain and try to swing the grid, say, 5.5 volts each way or between -10 and 1 volt. During a fraction of the cycle, you are working along the steep part of curve 111-A, the plate voltage will be changing rapidly and the amplification will be high. Every time the grid voltage exceeds -9, further changes have practically no effect on the plate voltage. The effect of this is to cut off the positive peaks of the plate voltage waves. If an attempt is made to push the grid positive, the preceding tube may be doing its best, but the grid keeps collecting electrons or negative charges and is thus prevented from reaching the positive potential which it would otherwise attain. The effect is to cut the negative peaks off the plate voltage waves. If the bias is not at the middle of the permissible grid voltage range, you would cut off more quickly at one extreme than at the other and get an unsymmetrical wave.

Mr. Frederick: The vacuum tube amplifier is without doubt an extremely beautiful and useful tool in this work. Since its development the art of transmission of intelligence has gone forward by leaps and bounds. There is naturally a tendency to consider the vacuum tube amplifier the cause, and all progress the effect. This is not altogether correct and the vacuum tube amplifier might well be considered the twin brother of these other developments. They have all resulted largely from a new consideration of effort along the lines of industrial research, particularly as applied to the art of communictaion of intelligence. This effort gave us the vacuum tube amplifier and it has also given many other things needed in solving our present-day communication problems. Had a vacuum tube amplifier never existed it would be an exceedingly rash assertion that we would not have had long distance communication or loud speaking systems such as we now have. In fact there are many of us that can remember using loud speakers before the first vacuum tube amplifiers were seen.

Mr. Crabtree: With the existing type of loud speaker, what is the minimum output necessary in order to reproduce a low note of a frequency of, say, 16 to 20, or frequencies of sound such as those produced by a falling building?

Mr. Kellogg: I can only answer that by saying we have not yet had an amplifier or loud speaker capable of reproducing such sounds with any approach to their original loudness. You can, perhaps, recall about how loud a sound you used to get from the receiving sets of four years ago. The amplifiers in those had an output of about 1/100th of a watt. When we put out the Radiola 104 loud speaker we put into it an amplifier capable of giving an undistorted output of 1 watt. The tubes most frequently used for auditorium speakers have an output capacity of about 20 watts. Amplifiers using from 1 to 4 such tubes in the power stage will reproduce the music of a small band with a fair approach to the original volume, but with considerable loss of the lowest frequency components. I think Mr. Maxfield may have some quantitative data on this subject.

Mr. Maxfield: We have no definite data. On the theatre installations, intensities equal to one-half or one-quarter of that of the original orchestra have been obtained.

A. F. of M. Campaign on "Canned Music"

THE American Federation of Musicians sponsoring a $2,000,000 advertising campaign in hundreds of daily newspapers and periodicals throughout America in an attempt to arouse opposition on the part of theatregoers to sound pictures which are referred to in the advertisements by the rather inelegant title of "canned music." This series of advertisements elicited much editorial comment outstanding among which is the following from *Liberty;*

"We think there is much in what it (the particular advertisement) said. No doubt there is more warmth and sympathy of feeling in a program rendered by musicians in the flesh and heard in a concert hall than in a mechanical reproduction of the same performance. But, at the same time, those who offer objections to "canned music" overlook the larger aspect of the case—namely, the many millions of people living in villages, towns, and the smaller cities, who could never by any possibility get into the great symphony concerts, can now hear far better music in their local picture houses than they could in the old days when the music for their pictures was furnished by a young lady at a piano.

Vast New Audience

"The same is true of acting. Perhaps, if you get a seat in the fourth row near the center, and see Katherine Cornell doing her stuff, you get a more vivid impression of what it is all about than you would if you saw a movie star doing her's.

"But the percentage of people who can get fourth-row seats to see Katherine Cornell, considering the country as a whole, must be extremely small, whereas the number of people who can hear and see everything Norma Shearer does in a small drama will run very high. . . fourth-row seats are not needed. You can hear her way up in the back gallery, and see her, because her face is enlarged.

"Some of the more celebrated theatre critics of the time, feeling perhaps that their occupations may be soon gone, are accustomed to sneer at the talkies. Well, we think they are the greatest advancement in dramatic art since the time of Shakespeare."

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a. p. 32, Jan., 1930, issue.
b. p. 33, Jan., 1930, issue.

Reducing
the Chance Element

RCA PHOTOPHONE INC SOUND EQUIPMENT

The price of effective sound reproduction is eternal vigilance. It involves the most exacting care of sound equipment.

But no man is infallible and thus it is that the equipment which assures the best reproduction is that which eliminates the human equation most.

In the case of RCA Photophone, automatic maintenance and control devices, such as the triplicate system of exciter lamps, minimize the element of chance.

In addition to these emergency devices, the projectionist of RCA Photophone reproduced pictures has at his command the services of trained experts to assist him in gaining the best results from this apparatus.

With an RCA Photophone in your booth, you are working not only with the world's most highly perfected sound reproducing equipment, but with the world's most carefully serviced apparatus. Such a combination means quality performance at all times.

RCA PHOTOPHONE, Inc.
SUBSIDIARY OF RADIO CORPORATION OF AMERICA
411 FIFTH AVENUE - NEW YORK CITY

ATLANTA: 101 MARIETTA STREET CHICAGO: 100 W. MONROE STREET KANSAS CITY, MO: DAVIDSON BLDG. DENVER: 817-17TH STREET SAN FRANCISCO: 235 MONTGOMERY STREET

As The EDITOR *Sees* IT

¶ *The Patent Battleline*

PUSH-PULL amplification, slits, C-bias, vacuum tubes, gas-filled tubes (for recording), loud speakers—to mention just a few of the units in sound picture apparati which are the subject at present of intense interest from the patent right viewpoint. One company claims this right, another claims the same right; two other companies join forces to fight the first-mentioned two to the bitter end over the same patent rights. Very often it happens that the dove of peace is permitted to hover over the scene of battle only long enough to enable the victors to strengthen their respective lines so that they may turn and claw each other in as inelegant a fashion as could possibly be imagined. What fascinating sport these patent battles must be to those companies who, while possibly short on moral rights to the invention at issue, are long on that substance which has come to be familiarly known as the "long green."

Yes, it must be a lot of fun for the jolly old patent departments of the large industrial corporations. But the fun is in the main confined to these patent department workers and, probably, to a mere handful of kindly old judges who have no choice but to sit and listen to as torrential a flow of verbal nonsense as has ever been released within the confines of a court building. Tricks there are to all trades, and patent departments certainly are not the exception to this adage. But, as we have set forth on more than one occasion in these columns, the antics of a corps of patent attorneys and their assistants are anything but amusing to the rank and file of the motion picture industry, and, as we see it, are particularly malodorous to the small independent exhibitor who is anxiously awaiting an opportunity to buy a good sound reproducing apparatus at a fair price and without any fear of subsequent headaches resulting from a suit for patent infringment—not to mention the loss of his precious cash.

Six months ago we pointed out that the sooner this business of patent rights was settled the sooner would the industry be able to settle down and devote its major interest to selling tickets at the box-offices. This activity is the most important phase of the motion picture business, and when the work is being pushed on all fronts everyone in the business profits thereby. Conditions would be stabilized: more sound picture outfits would be installed; more sound picture theatres would be served by the producer for a larger "take"; more people would be given employment; and, possibly, Louise Bittersweet of Hollywood would be able to get a raise and buy an extra poodle dog or so.

Let those who have valid claims on this or that patent enforce their rights to the limit—that is, if they can; but let those imposters who have nothing and yet claim everything (including television rights)—let them be silenced permanently. We wish this latter group the worst of luck.

¶ *An Exposé and an Invitation*

WE have been pleasantly surprised of recent weeks to be the recipient of so many fine communications from our readers on various matters which have to do with projection room technique and equipment. We must confess that often in the past we have been in utter despair at the apparent lack of interest manifested by projectionists in general with regard to several subjects which we thought of enough importance to present to them for their consideration and, we hoped ('tho in vain), their enlightening comment. But important subjects came and went, and nary a word from our valiant readers. But, though our readers may possibly be valiant they *positively* are vigilant, for it required but a minute typographical (?) error—a twisted equation, let us say—to evoke a deluge of correspondence, mostly derogatory to our mentality or our eyesight. In the light of such happenings, we often were tempted to deliberately err in the hope that our mail bag would be filled to overflowing;—but the ethics of the proposition put such thoughts to rout.

Frankly though, we thrive on controversy—constructive controversy. Elsewhere in this issue appears some very interesting comment on the matter of reel sizes; and it is fitting at this time to extend to F. P. Broadbent of Edmonton, Canada, our heartfelt thanks for the first honest-to-goodness controversy it has been our pleasure to conduct, or oversee, so to speak. If the subject of reel sizes is provocative of such an instructive exchange of opinion from projectionists the country over, surely there must be a thousand and one thoughts on other subjects only awaiting the magic words to set them tumbling from the mind onto paper.

These magic words, it seems to us, are *do it.* The most interesting editorial matter we have published in these pages has come from individual projectionists who from all appearances were unburdened with one or more college or university degrees, much less with the title "engineer." Such exchange of information, in addition to providing a welcome contrast to the purely theoretical, will go far to gain the goal of standardization toward which we all are, or should be, driving. Let us hope that these few words will serve as the spark to set off bigger and better controversies.

This Matter of Film Reel Size

By JAMES J. FINN

WITHIN the past few months there has developed considerable agitation on the point of sound film reel sizes. One camp, comprised in the main of producers, hold that single reels are preferable; the other camp, in which the majority of projectionists seem to be, takes the stand that double, or 2,000-foot, reels are easily the most practicable for proper presentation of sound pictures. Considerable data on this subject has appeared in these columns to date, with neither side having proved its case, although it might be said that the proponents of double reels have given more tangible reasons for their preference than have the adherents of the single reels.

Thus far the controversy has developed nothing which might point the way to a solution of the problem; and meanwhile thousands of projection machines are whirring in as many theatres, with projectionists being left to make their own choice as to how their show shall be run. It is doubtful, however, if this preference will long be their privilege, for some Local Unions have already passed rulings prohibiting the use of double reels, and of late the International Alliance office has been appealed to by one of the leading film producers to aid in securing the adoption of the single reel by the general membership.

Film producers hold the upper hand in the controversy to date by virtue of the fact that they are able to ship out their own film on whatever size reel they choose; but, of course, it does not follow that the mere preference of the producers as expressed in their selection of single reels for the original shipment will insure the film being run "as is." This practice of the producers in arbitrarily setting up the single reel as standard may meet with temporary success by virtue of the fact that many theatres are not equipped with spare double reels on which to run the show, but it is extremely doubtful if the move will force the submission of many projectionists for more than a week, at most. The logical course to pursue would be to have a joint meeting of producer and projectionist representatives at which time the relative merits or demerits of both reel sizes could be gone into thoroughly. There is argument enough available to make such a meeting desirable; and it might be said that the present serious defects in sound film presentation which result from the use of two reel sizes cost the producers themselves considerable money daily in damaged film. (This damage figure, while large, would not include the material damage incurred by the exhibition end of the industry through loss of goodwill because of ragged sound shows.)

Ask I. A. Cooperation

There is included herein a letter written recently by Sidney Kent, general manager of Paramount Famous Lasky Corp. to President William F. Canavan of the International Alliance anent this important matter. President Canavan's reply is also given here. Mr. Kent's letter:

December 9, 1929.

Dear Mr. Canavan:

When I saw you the other day I meant to mention to you a matter which is of extreme importance to us and on which I hope I can secure your help.

We are having a great deal of trouble with the operators throughout the country taking our sound reels, putting two of them together and mounting them into double reels in 2,000 reel lengths. Every time they do this they cause a loss of synchronization through elimination of frames in mounting and remounting, and many times this is done without our knowing it because they are put back in the original one-reel form in which they were shipped to the theatre, but without any knowledge on our part of the frames being taken out.

In some of your locals they have cooperated with us and have forbidden their operators to do this. In the long run it hits right back at all of us, because if quality reproduction cannot be had in the theatre it reflects against every branch of the industry, including yourselves, and I know that your attitude has always been to co-operate in getting the finest quality out of sound that we can.

Is there any way in which you could assist with your national organization in calling this situation to their attention? We would deeply appreciate it if you would do so.

Sincerely,
SIDNEY KENT.

December 17th, 1929.

Dear Mr. Kent:

Your letter under date of December 9th, with reference to the doubling of sound reels will be published in full in our Official International Publication, which reaches our entire membership. In addition, our local unions will all be instructed to comply with your request. In the specific instances where the practice complained of continues, a line from you designating the particular locality will bring the result you seek.

Our organization is always earnestly striving for better screen results.

With kind regards, I remain,

Sincerely yours,
WILLIAM F. CANAVAN,
International President.

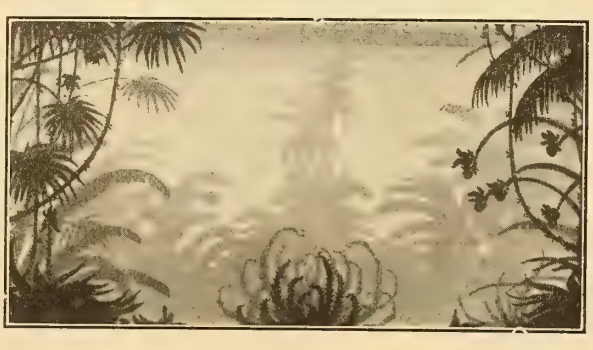
It is interesting to note the salient features of the arguments put forth by both sides of this controversy. Representative opinions which follow are those of two Local Union Secretaries. From George L. McCann, Secretary of L. U. 312, Enid, Oklahoma, comes the following expression:

5 Votes for Singles

1. In running double reels the exciting lamp is on twice as long, thereby being subjected to undue strain which weakens it. An exciting lamp should be allowed to cool after each single reel. 2. We object to being forced to stand alongside our projectors for a period of twenty minutes or longer, which is demanded by double-reel operation. 3. Some states, assuming that double reels will give rise to laxness on the part of the projectionist, have passed laws forbidding their use. 4. Most of our programs consist of part sound-on-film and part disc, and we imagine that it would be somewhat confusing to have part of the show on 1,000-foot reels and the other on 2,000-foot reels. 5. New York City Local 306 recently passed a ruling forbidding any projectionist in their jurisdiction to hook-up double reels for use in a theatre. In view of the fact that 306 is not only the largest Local Union but has also had sound equipment longer than any body in the country, we assume this action was based on



Two novel effect slides recently added to the Workstel library



long experience and with an eye to better projection.

We would suggest that the disc companies, instead of trying to make 2,000-foot reels for their subjects, continue the use of single reels and encouraging the few companies who now favor the former to use only singles.

From Secretary H. T. Coleman of L. U. 567, Boone, Iowa, comes another opinion in favor of single reels:

I will admit that the practice of shipping this product on 1,000-foot reels has done much to mar the presentation of many sound pictures, but why blame it on the reels when the majority of the time the reason for mutilated prints is the projectionist who on a prior run has cut into these prints? Personally I come across too many evidences of projectionist delinquency in this matter.

Brother Broadbent further states that nobody runs subjects, either silent or sound, on single reels; yet he would be surprised to learn that out this way there are hundreds of us who do that little thing. The fire hazard alone is enough argument in favor of the single reel:—two reels of film will make just that much more of a fire than a single reel.

A projector take-up with enough tension to take-up a 2,000-foot reel would in all cases cause too much tension on the first 100 feet or so of film, particularly in the older projector models. Then there is the matter of the exciting lamp filament. I understand that running 2,000 feet of film demands that the exciting lamp be lighted for too long a period, whereas the single reels allow it a chance to cool after a short period and adds materially to the life of the lamp.

Most of the leading film producers in this territory send out letters with each and every print requesting us not to double up their sound-on-film prints and state that if the same is done we will be charged accordingly.

If a uniform reel standard could be agreed upon throughout the industry, there would be so few bad changeovers due to mutilated prints as to be negligible.

Let us examine the objections to double reels as set forth in the foregoing communications. Authoritative data is available showing that an exciting lamp should and will burn 100 hours irrespective of whether it be burned consecutively for 10 minutes, 10 hours or 50 hours. Just where this exciting lamp fable originated is not quite clear, but it may be said that it is only a fairy tale.

Legislation against the double reel, whether by Local Unions, municipal or State authorities, merely reflects the point of view of those responsible for the legislation and contributes nothing to a rational solution of the problem. The argument that the use of double reels gives rise to laxness on the part of the projectionist is rather far-fetched; projectionists have greater responsibilities these days than ever before, and if they may not be trusted to function as efficiently with double reels as with single reels, then they have no business in the projection room.

The Fire Hazard

The point made about excessive tension is a fair one, but the writer has yet to see a show ruined as a result of same. Further, about the fire hazard: we doubt that there is a greater margin of safety with a fire of one reel of film than with a fire of two reels of film; the projectionist's responsibility is as great in either case and the hardships imposed by fire are exactly the same in both cases. If protection against fire is desired, have a fire prevention device installed.

It cannot be denied that it is much more convenient for film producers to ship film on single reels: their exchange and delivery service is based on a single reel standard. And we must not forget that they have so many thousands of single reels on hand, replacement of which by double reels would involve a large cash outlay.

A communication from Secretary Emil Holz of L. U. 224, Washington, D. C., sets forth the projectionist point of view on this matter as expressed by a majority of his Local membership; and it might be added that this viewpoint of the projectionist coincides in many instances with the producer's interest. Mr. Holz's letter:

In the interest of better projection, we, the members of Local 224, Washington, D. C., herein set forth our attitude regarding the use of 2000-ft. reels for sound-on-film projection. We are therefore calling to your attention the following facts as we see them.

1. The beginning and ending of reels of film are always the first to become scratched and abrased causing "rain" and surface noise in sound projection.

In many cases three reels could be hooked up on a 2000-ft. reel which would do away with one half or more of this damage.

2. One recent release on 12 reels, averaged less than 600 feet per reel. With film recording this show could easily have been put on four 2000-ft. reels. With disc it could have been put on 9 reels, if the producer had been inclined to give the projectionists who are unlucky enough to have to run this show any consideration at all.

The Human Element

3. It is customary in any enterprise to take into consideration the human element and to remove as far as possible the chances of error and the making of mistakes. We projectionists are not super men, and when we are working under the high pressure conditions existing in the projection rooms today the chances of making mistakes are greatly increased.

The fewer changeovers that are necessary, the less the chances of forgetting some little thing which would mar an otherwise smooth show. This also applies to mechanical breaks not necessarily the fault of the projectionist.

4. The theory has been advanced that the exciting lamp should not be kept on for the period of time necessary to run a 2000-ft. reel; but it is a known fact that in many theatres the exciting lamp is kept on all during a show by orders of the house so as to keep the noise of lighting-up out of the house. These lamps are not expensive and often last for months. This also goes for B-batteries which last much longer.

Take-Up Tension

5. It has been also said that the take-up strain is too great on 2000-ft. reels. This is an error if big hub reels are used as a simple problem in arithmetic will prove.

On the other hand, look at the outfits which still use small hub reels on their take-ups, which they would have to stop if it became general to use 2000-ft. reels. With the modern machines, which are mechanically in good condition, this is rather a poor excuse for the above argument.

6. The producer most active in this campaign against 2000-ft. reels has the least consideration for the projectionist of any of the producers, in that they put out the smallest reels, the most unreliable cue sheets and the greatest volume changes in their productions.

They are now attempting to take an unfair advantage of the exhibitors and their public by sending to the houses which are equipped only for disc reproduction and have no provision for marking out sound track or enlarging to standard screen size, sound-on-film prints with the sound track not blocked out and with duped records.

This reflects on the men in the projection room in the eyes of the audience, *as we know from reports to our business headquarters.*

7. We further contend that the large reels would be an advantage to the producer and exchange as less leaders, titles, block out for starting, etc., are necessary. Therefore there is less shipping weight and more compact boxes.

Furthermore, if large reels are used, the exchange shipping reels would be used on last show, as take-up reels, and the film would be returned reversed and, more important, wound flat, doing away with damage to the edges of the film.

Rewinding Evils

Any man who has studied this problem knows that more damage is caused to film by unequal rewinding on poor shipping reels in transit than all other bad conditions in the industry. This condition certainly cannot be blamed on the projectionist.

8. We also wish to point out that the large reel causes less damage to beginnings and endings of reels. They are easier and quicker to inspect in getting ready for a showing. This last would also apply to inspection at the exchange—(*if and when they are inspected*).

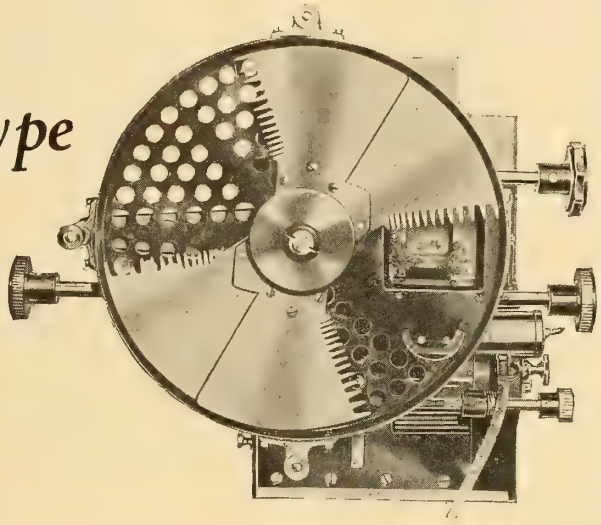
9. Finally, where projection rooms are equipped with two machines there are often occasions where more time is needed to do little things to the equipment or film than is available

(*Continued on page* 40)

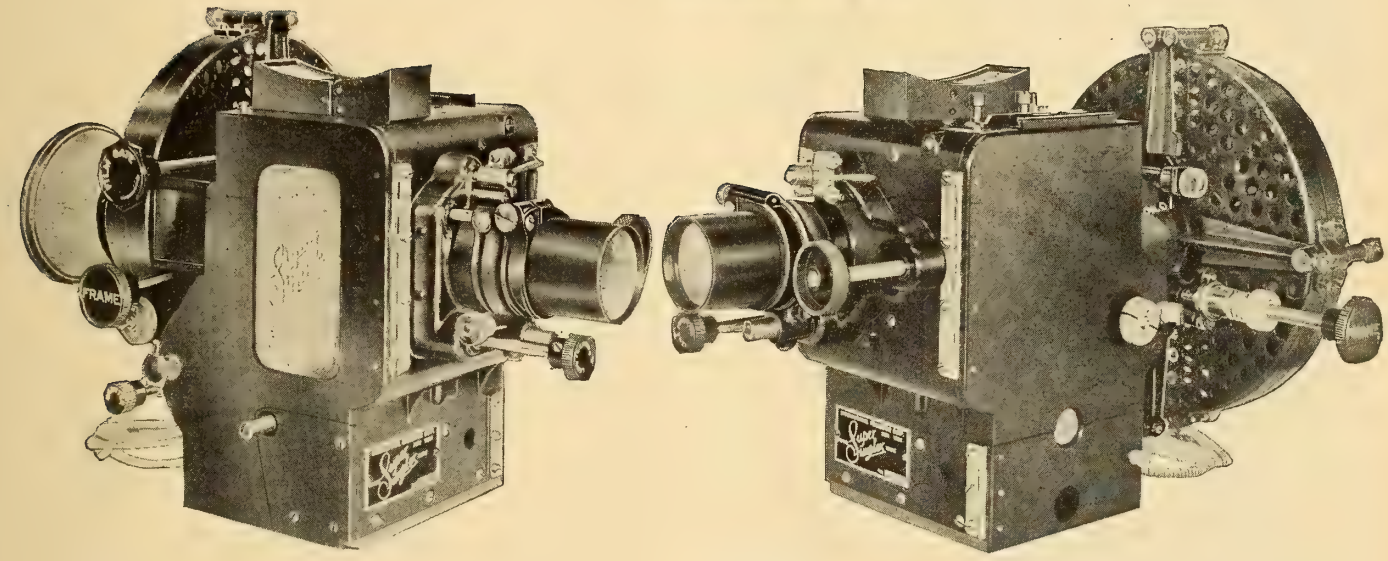
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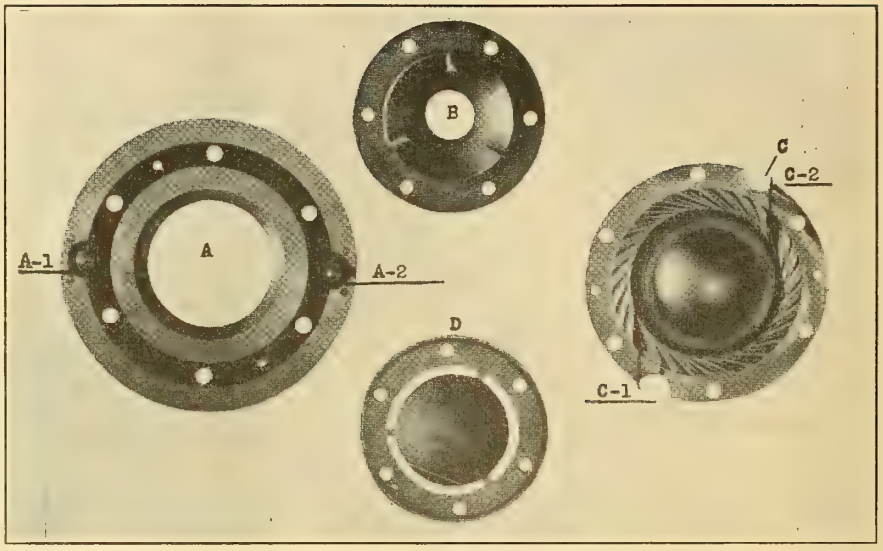
Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

MANY projectionists are now classed as technicians, and rightly so, and are able to keep the show going in case the sound equipment ceases to function. However, there are still a great many who lack confidence because of insufficient knowledge. It is our desire to furnish you with such information that will be of value and assistance to you in keeping the show going and enabling you to make the proper adjustments to produce the best sound reproduction. Good results with sound reproducing equipment may be had only by the untiring efforts of the projectionist to add to his knowledge.

While we do not believe that television will be available for general amusement purposes for quite sometime yet, wide film is now nearly ready for distribution to theatres on a large scale. We projectionists must be ready to handle this development with ease of operation. Stage attractions and large orchestras have been either eliminated or greatly curtailed in a majority of motion picture theatres, and it is now directly up to the projectionist to handle sound picture productions in such a manner that an audience will not be conscious of the lack of these so-called props of the show world.



A, mounting plate. C, diaphragm and actuating coil. Note C-1 and C-2, leads from diaphragm actuating coil. A small part of lead C-2 is broken off, typical of many speakers which do not function. B and D form tone chamber for air pressure waves.

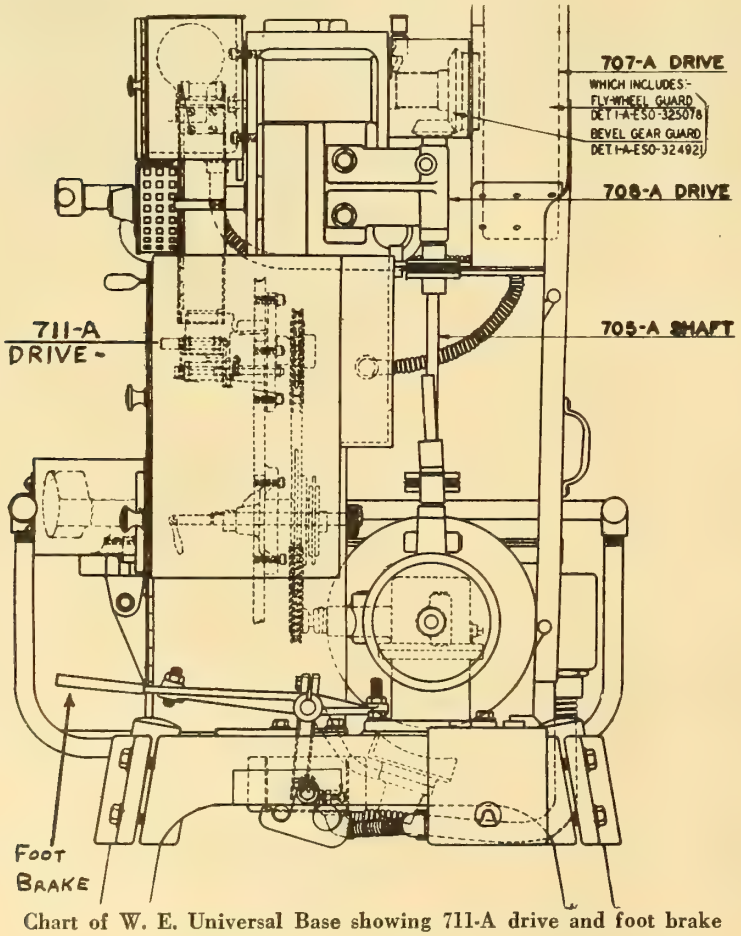


Chart of W. E. Universal Base showing 711-A drive and foot brake

711-A Drive

The 711-A drive is located in the lower, or take-up, magazine on the Western Electric universal base. It is my opinion that thousands of dollars' worth of film has been damaged as a direct result of certain features of this drive. The purpose of the drive is to eliminate the uneven take-up pull from the film reproducing mechanism. There is a slack of two sprocket holes between the sound sprocket and the take-up sprocket in the lower magazine which insures an even and steady travel for the film as it passes through the film reproducing mechanism, which eliminates flutter.

The manufacturers of the universal base have been advised of the trouble which has been encountered with the 711-A drive and the film damage resulting therefrom; but they have taken no steps to remedy the fault.

However, we have adopted our own expedient to correct this situation. At the present time the 711-A is installed in such a manner that only a few sprocket teeth are inserted in the film sprocket perforations at all times, which is insufficient. As the film passes through the film reproducing mechanism and over the take-up sprocket—supposing an over size patch passes over this sprocket and the take-up is pulling a bit too hard (which should not be the case)—the sprocket perforations will jump the sprocket teeth and the film will ride the teeth, with the result that a length of film—possibly the entire reel—will be ruined.

Another angle of this situation which has caused no little concern is that this take-up sprocket is located in the lower magazine, and while it is damaging film it is not perceptible when the lower magazine door is closed.

Necessary Changes

There are three screws which hold the 711-A drive in position. Loosen these screws, which will release the take-up chain and the drive. Rotate the drive to the next screw hole. In order to make the drive fit it is necessary to cut the round part of the casting off straight, so that it will fit up against the main casting. This can be done in a very short time. Fasten the drive in a vise and use a hacksaw to cut from the casting that part which is necessary.

After you have installed the drive you will notice that the metal film stripper is in the way of the film chute; this will also have to be removed and cut, so that this stripper will miss the film as it comes over the lower magazine take-up sprocket. After you have rotated the drive you will notice that the sprocket idler will be rotated one-quarter of a turn toward the take-up reel. There will be nine sprocket teeth inserted in the sprocket perforations instead of only a few as was the case before the drive was rotated. This will eliminate the possibility of the film jumping the sprocket and damaging film.

The Foot Brake

Projectionists should never use the foot brake furnished with the universal base except in case of a film break or in extreme emergency. Of late there have come to my attention several instances where the projectionist pushed his foot down on the foot brake and then proceeded to forget completely about it until the changeover was being made. Upon discovering his error he would pull the foot brake back into position and go ahead with the show; but he causes a pause between reels which invites the criticism of the audience.

Receiver Troubles

Practically every theatre which has Western Electric equipment has experienced the replacement of the 555-W receiver unit, and there has always been a question as to just what was the nature of the trouble which caused the unit to cease to function. Gun shots, cannon shots, bombs, blasting and other effects produced with increased volume have been the cause of replacing many of these receivers.

Audio current circulates through the actuating coil, interacted with a steady magnetic field, forcing the diaphragm in and out. This coil is mounted rigidly on the diaphragm, which in turn is corrugated between the coil and the clamped edge to prevent resonance. However, I have found that the internal connections, connected to L No. 1 and L No. 2 of the speech circuit, break off at the terminal, which leaves the speech circuit open. The accompanying photograph shows leads from the driving or actuating coils. You will note that one of these leads broke off in the same manner, as shown at C-2.

Flutter

During a recent visit to a theatre I noticed a very bad flutter on one sound projector, the result of which was the absolute ruination of the sound reproduction. The projectionists had checked the equipment carefully in an attempt to locate the source of the trouble but their quest was unsuccessful. After rather a lengthy search by all hands it was discovered that the couplings on the 705-A shaft, which drives the Movietone mechanism on the Western Electric universal base, had become loose. A general tightening of this unit eliminated the flutter.

Disc Noises

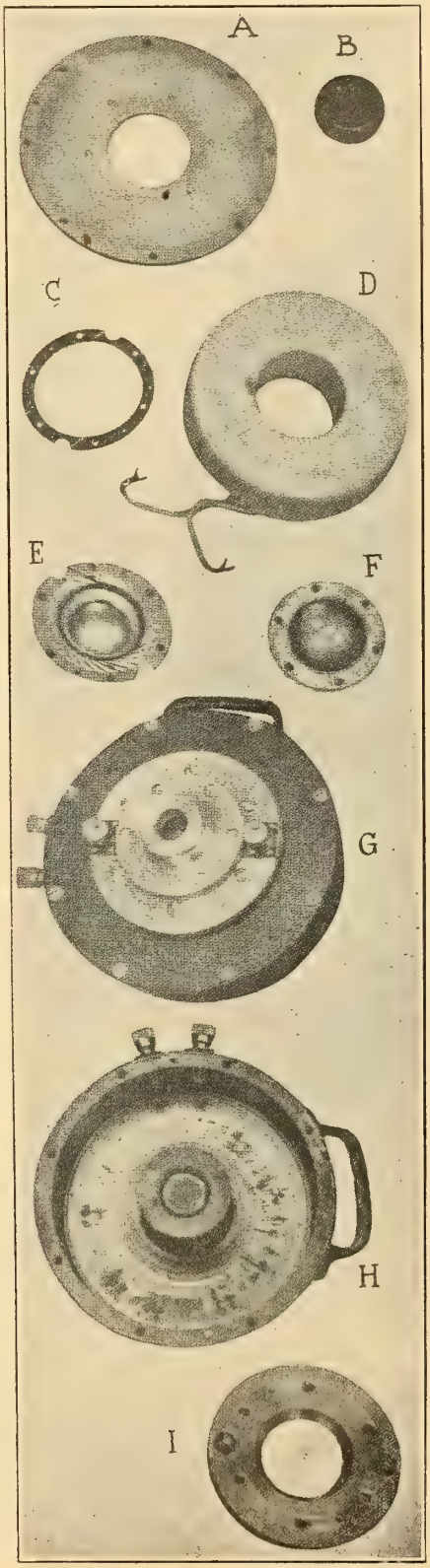
Excessive needle scratching is due to imperfect recording (over which the projectionist has no control). Worn records and excessive volume will also result in needle noise, or it may be that the equalizer has been cut out of the reproducer circuit.

GREAT care must be exercised in threading the projector for film reproduction, otherwise lack of synchronism will be the result. When threading a Simplex projector for film reproduction, thread in the usual manner with the exception that the loop between the intermittent sprocket and lower sprocket should be such that the film just comes in line with the edge of the mechanism. For Powers and Motiograph mechanisms allow a two-finger loop between the intermittent and the lower sprocket. There should be a length of 19⅓ frames, or 14½ inches between the center of the projector aperture and the light gate aperture in the reproducing mechanism. In threading from the projector mechanism lower sprocket to the sprocket of the reproducing mechanism always allow the slack of two sprocket holes.

Filter Condensers

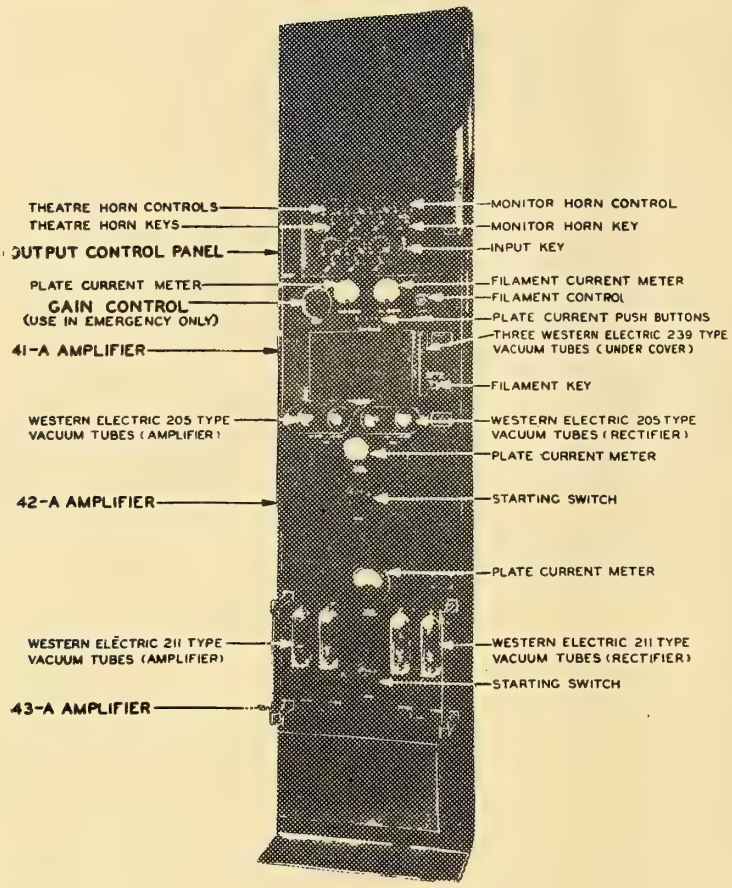
High-voltage filter condensers are capable of holding a charge for a considerable length of time. It is possible, while checking over the amplifier and component parts, that one may receive a severe shock from one of the condensers. A simple method of avoiding such shocks is to make a practice of always discharging such condensers before handling them. To eliminate the possibility of shocks, take a screwdriver or any other metal conductor and short both terminals, which will discharge the condenser.

The management of one theatre complained that the volume secured with disc was so much louder than that with film on both projectors. We assumed, of course, that at this stage of sound reproduction work every projectionist manifested an active interest in securing information on his equipment and that he would never neglect to do those things which are



Component Parts of the 555-W Western Electric Receiver

A, cover plate. B is a screw cap, which is used to protect the threaded boss, which permits the attachment to the horn. This cap should always be placed on the receiver unit, when not attached to the horn. C. is an insulator, which is placed between the clamped edge of the diaphragm and the mounting plate. D is the field coil, which energizes the diaphrgam E. E is the diaphragm with an actuating coil. F, damping plug, which fits over front of mounting plate. G, complete 555-W receiver ready for installation. H, main casing. I, plate upon which is mounted the diaphragm.



W. E. 2-S system which, except for 43-A amplifier at bottom, is same as 1-S panel

now regarded as the veriest fundamentals of sound picture work. In this particular case, however, I was surprised to find both excited lamps very dirty and not focussed properly; besides, oil had completely covered the front lens of the Movietone lens assembly.

There is absolutely no excuse for the existence of such conditions.

If the reading on the synchronous motor control box meter does not stay within specified limits, check the projector mechanism immediately, and also the working parts of the driving attachment. Excessive friction at some point in the mechanism will cause the meter reading to read high on A. C., or too low on D. C. See that the projector working parts are lubricated at regular intervals.

Checking Discs

One of the most important duties of the projectionist is the checking of records. If, despite the fact that the record is all right, the needle jumps the groove, check the reproducer to see that it is tracking properly. On many occasions it has been found that the reproducer was dragging the record. Under these conditions try a new needle; if the trouble persists, block up the reproducer arm by inserting a small piece of rubber eraser between the under side of the arm at the rear end and pivot base, so as to raise the reproducer clear of the record and allow it to swing freely.

Test amplifier equipment daily before starting the show. After the amplifier has been turned on, test the disc pick-up by rubbing the needle lightly with the finger. This sound should be clearly heard in the monitor horn. In testing the film pick-up, see that the exciter lamp filament current is at proper value. Remove the light gate. Move the finger up and down across the light beam. Every time this is done a click should be heard in the monitor horn. Test each projector in the same manner.

Line Testing

Never use a battery and buzzer to test lines for opens or shorts in amplifier or reproducing circuits, as this may upset the magnetic characteristics of the coils. Use a head set to test amplifier circuits. Before removing the rear cover of any amplifier panel be sure to turn off the power and keep it off until the cover is replaced.

If the observer's equipment does not function, and if either the observer or projectionist is unable to hear each other, or if the buzzer is weak or inoperative, make sure that the batteries are in good condition. The battery box may be opened by loosening the screw in the cover.

Use of Footage Counter To Maintain Synchronism

By Charles F. Wide

Local Union 279

WHEN running Vitaphone dialogue subjects, should the film tear at or above the top feed sprocket, synchronism is destroyed. The damaged film must be replaced by the exact number of frames which have been cut out and it is also necessary to again start from the beginning of the reel, unless the break occurs near the end of the reel, in which case the rule is to proceed right along with the next reel. All this trouble may be avoided by means of a small outlay for a footage revolution counter for each projector. In fact, many theatres now have every projector so equipped.

The procedure in threading is as follows: turn handwheel until trigger on footage counter has completed its register, with no lap-over. Now clear the footage dial until all figures are at zero. The film is now threaded with the starting mark at the aperture, and needle is at starting mark on the disc.

Match Frames with Counter

We know that Vitaphone film is marked with footage numbers every 16 frames and that the starting frame is #0. It is evident that when footage recorder shows 1, the film will correspond with it by the footage #1 printed on its edge, and as long as the reel has exactly 16 frames to each printed number, this relation will always be maintained.

Should the film tear above the top sprocket, proceed as follows: douse the light and bring down the fader. Use the foot brake to stop the machine. *Do not* touch the record or tone arm. Turn handwheel until the trigger, or footage counter, has just completed its register of an additional foot. Read the total footage on the counter dial and find the corresponding number on the edge of the film. The frame opposite this number is to be threaded in position in the aperture.

Under these conditions it will be possible to maintain synchronism even in the event of a break.

British Patent Trend

During 1928 and 1929, 256 patents have been granted in Great Britain for devices connected with films. Of these 52 deal with color, 57 with sound, 21 with stereoscopic processes, 8 with continual motion, 10 with safety devices, 9 cover the construction of new machines, 5 refer to new processes for the production of films, 30 with processes for perfecting such material and the rest deals with miscellaneous inventions connected with motion pictures.

Equipment Troubles and Maintenance

By C. R. TRAVIS

IN this installment we shall analyze the amplification units, a sound reproducing apparatus and shall consider the electrical actions which take place behind the amplifier panels and inside the vacuum tubes. We often hear the vacuum tube cited as the heart of the amplifier, but from this point on the information given on this highly important unit has generally been a mass of confusing terms and intricate figures. The following step-by-step analogous explanation seems to the writer to be the best method of explaining the action of a vacuum tube.

Pick up any vacuum tube that you happen to have at hand which is not coated on the outside and which is so designed that all the elements are clearly visible. You will note that the filament is in the mechanical center and is the part that glows when a current is applied. Some filaments are nearly a loop; others assume a "V" shape, helical or an inverted "W." Fig. 1 shows some of the various forms this important part of the tube assumes.

Tube Filaments

All filaments are for only one purpose: to heat some *electron-emitting material to a temperature at which it will throw off electrons.* There is nothing particularly alarming about the term *electron.* It designates merely a minute particle of electricity that is thrown off by the coating on the filament. With proper filament design it is possible to have these minute particles of electricity (electrons), thrown off at the rate of billions per second. Considering that the filament is a small ball suspended in a vacuum the electrons naturally would leave it in all directions. These small particles travel with the speed of light, or at the rate of 186,000 miles per second.

It is a fundamental law of nature that electrons are always negative in polarity. Many will recall the grammar school physics experiment in which two bar magnets are placed in various positions and it is eventually determined that unlike poles attract each other and that like poles repel each other. It is also a fundamental law that electrons will respond to the laws of magnetism. Thus we can expect that if we place a body containing a positive charge somewhere in the vicinity of these flying bits of negative electricity the latter will be attracted to it; and if we place a negatively-charged body in their vicinity, they will be repelled from it.



Fig. 1. Three filaments; Fig. 4. Two grids

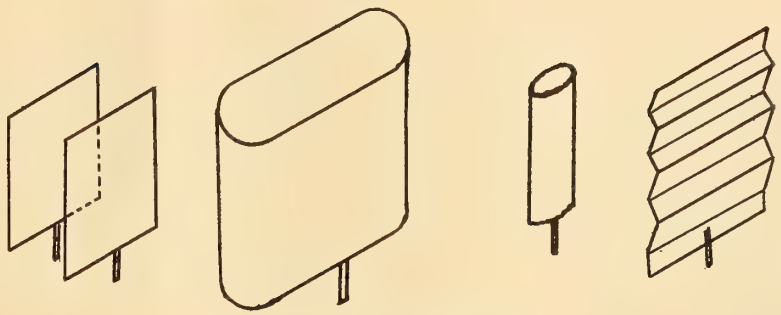


Fig. 2. Types of plates

Once more looking at our vacuum tube we see farthest away from the filament a solid metal disc or square known as the *plate.* Other shapes are illustrated in Fig. 2. This invariably appears on both sides or in the form of a cylinder completely surrounding the other elements in the tube. The plate of the tube is the part that contains the positive charge. Therefore, we can expect that the plate will collect the majority of the electrons thrown off by the coating on the filament inasmuch as the negatively-charged electrons and the positively-charged plate will set up a mutual attraction for each other. The next question to consider is, how can the plate be made positive? Quite simple.

Suppose that we take a battery of any voltage and connect its positive terminal to the plate of the tube, and its negative terminal to some point on the filament of the tube. Then the plate becomes positive with respect to the filament. Fig. 3 shows the principle involved. It is precisely the same thing as making one carbon of your arc lamp positive and the other negative. Now assuming that the filament of our vacuum tube is lighted and that its coating is emitting electrons which are being attracted to the plate due to the positive charge being placed there by a battery. The stream of electrons have the property of acting similar to any conductor of electricity—that is, they will replace a wire or the electrolyte of a storage battery or any of the hundreds of conductors of electricity.

Controlling the Current

Without the gasses generated in the flame of an arc lamp the circuit is open, is it not? Likewise, without the flow of electrons between the filament and plate of the vacuum tube the circuit between the plate and filament of the tube will be open and no current will flow in the battery circuit that is connected to the plate (Fig. 3). Also, we must accept as fact that a change in the number of electrons flowing between the filament and plate of the tube will change the resistance of this gap, and we can then expect a change in the amount of current flow. Thus, with more electrons we can expect that the resistance will be lowered with a resulting increase in current in the plate circuit; with fewer electrons flowing the resistance will be increased with a lowering of the current in the plate circuit. It is logical to assume, then, that if we can discover a method of controlling the electron flow, we can control the amount of current flowing from the plate to the filament.

It was previously stated that electrons would respond to the fundamental law of magnets. Suppose that we place some type of body between the filament and plate of our vacuum tube on which we can place a charge of some type. Obviously, any type of solid body is out of the question due to the fact that there would be no chance for the electrons to obtain their objective of reaching the plate except by some devious route. The structure must therefore be some type of grille work. Those commonly used are represented in Fig. 4, in which a number of small wires are assembled on a frame of some type and in such a manner as to place themselves between the filament and the plate of the tube. If

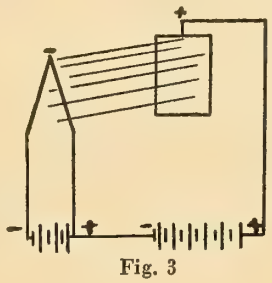


Fig. 3

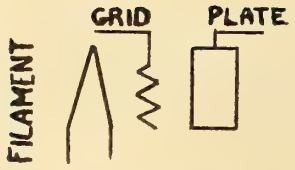


Fig. 5. Symbols

on this grille, or grid, we place a negative charge we can expect that some of the electrons are going to be repelled back to the filament, and that if we increase this negative charge sufficiently we shall be able to force all of the electrons back to the filament and none will reach the plate.

We showed previously that by controlling the number of electrons flowing between the filament and plate of the tube we could control the current flowing in the plate circuit, so that we now have a completed three-element vacuum tube. We must also accept as fact that for a given change in the charge on the grid circuit, there will be a proportionate and definite change in the electron flow and a resulting proportionate and definite change in the flow of current in the plate circuit.

Definition of Terms

Definition of common terms used is as follows:

"A" battery, or filament supply: The battery or generator or transformer used to supply the voltage and current to light the filaments of the vacuum tubes. It is dependent for its values upon the type of tube used. The current that flows in the filament of the vacuum tube is known as the filament current, or "A" current.

"B" Supply, or plate battery: The battery applied to the plate of the tube is known as the "B" battery and may be supplied by batteries, a generator, or power pack. The current that flows between the plate and filament is known as the space current or plate current or current in the plate circuit.

"C" Battery: The battery in the grid circuit of the tube is known as the "C" battery and is usually supplied by a battery but is sometimes supplied from a power pack. The emission of electrons by the heated coating of the filament is known as the emission of the tube and should be standard within permissible limits for all tubes of the same type.

It would be well to remember the above definitions so that you will be familiar with the terms commonly employed in all amplifier work.

Vacuum Tube Circuit

We will now try to find a use for this completed three-element vacuum tube and try to assemble it in a circuit that will be of some use to us. Let us consider Fig. 6 and remove the transformers from either end of the drawing and connect, as shown by the dotted lines, the points 1 and 2, and 3 and 4. You will notice that the vacuum tube represented therein shows the grid in its natural position between the plate and filament. The drawing shows the various batteries connected in a simple form. You will note that by changing the value of the "C" battery one is able to make the grid either more or less negative with respect to the filament and thus control the electron flow. However, this is a purely mechanical affair and is of no use whatsoever for the purposes we have in mind. So we must proceed a little further along the line of research and find out still other facts.

Suppose that we have a wave like that shown in Fig. 7, derived from a generator, a magnetic pickup, a photo electric cell or any other source. It is apparent that the wave starts out at a point that has zero voltage and ascends until it reaches some maximum point (in this case, positive three volts), and then returns to zero and continues in the opposite direction until it reaches some point (maximum in this case, three volts negative), and then returns to zero. This completes one of those mystifying actions known as a *cycle*. It may be of any frequency. That is to say, it may do this several thousand or hundreds of thousands of times per second or it may do it only once in an hour, but it has gone to the positive side of some zero mark and returned only to go in the opposite direction and return. The number of times that this happens per second determines its frequency. Thus a one hundred cycle note would perform this operation one hundred times per second.

Application to Grid

Assuming that we have this hundred cycle note in the form of electrical energy on a pair of wires, how can we apply it to the grid of the vacuum tube so that we can obtain the benefit of the voltage change that exists? Let us terminate our pair of wires in the primary of a transformer, the impedance, or alternating current resistance of which will closely match that of the source of energy. With this condition met we will have the greatest possible transfer of energy. Likewise, the impedance of the secondary of the transformer must approximate that of the grid of the tube. Now let us remove the straps that we placed on 1 and 2, and 3 and 4 of Fig. 6, and in their place connect the secondary of the input

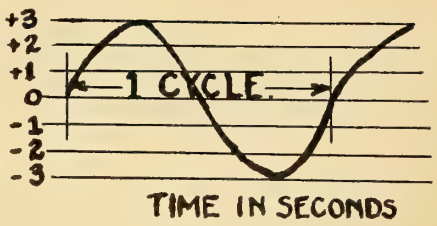


Fig. 7

transformer, as shown by the dotted lines, to terminals 1 and 2 and the primary of the output transformer to the terminals 3 and 4.

Let us consider that the value of our "C" battery in this case is 4 volts, so that when our superimposed wave is on zero the applied voltage to the grid is 4 volts negative. Now let us assume that the wave has started up and that it has reached the point of + 1 volt on Fig. 7. Assuming that the transformer we are using is of 1 to 1 ratio, or, that for 1 volt induced in the primary there will be one volt induced in the secondary, we will now have an additional charge placed on the grid of positive 1 volt. If we add this new potential to that of the potential (4 volts negative), applied by the "C" battery, we find that we have a negative charge of only 3 volts applied to the grid of the tube. Assume again that our source of potential has reached its positive maximum of 3 volts, and by like arithmetic we find that the grid potential has now only a negative potential of 1 volt.

The same remains true as the external potential returns to zero. As it descends towards its maximum negative we find that the grid gradually becomes more negative. Thus, at 1 volt negative of the external potential we find that the grid becomes 5 volts negative due to the additional 4 volts negative of the "C" battery, and when the external potential reaches the maximum negative value of 3 volts, the grid becomes a total of 7 volts negative. Thus our outside source of potential is being made to apply itself to the grid of the vacuum tube and we know that this change in the grid potential will affect the number of electrons flowing between the plate and filament and that the current will change in the plate circuit as a result.

Use of Transformers

Therefore we have only to devise a way of obtaining the benefit of this current change. If we take this

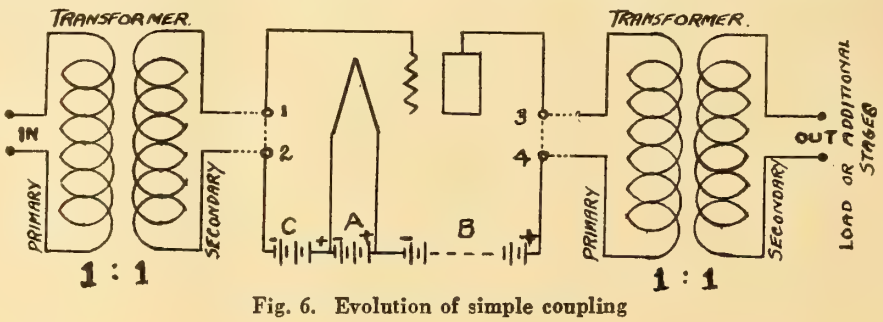


Fig. 6. Evolution of simple coupling

changing current through the primary winding of the transformer represented in Fig. 6, as connected to the terminals 3 and 4, and remove the strap, then the current will be forced to travel through this winding, and we can expect to receive electric energy of the same wave form as was introduced into the primary of the transformer in the grid circuit. The amount of amplification received at the output is dependent upon the turns ratio of the input transformer and the *gain*, or *amplification factor*, of the tube used.

Inasmuch as the grid action of the tube is not dependent upon the current supplied but only upon the impressed voltage, it is customary to use a step-up transformer or one that will increase the voltage at the expense of the current. Thus, a 3 to 1 transformer ratio would raise the original maximum voltage change of 6 volts to 18 volts (+ 3 to zero to — 3 volts being a 6 volt change), and supply this voltage to the grid circuit of the tube. Transformers with a ratio of more than 3 to 1 are not generally used due to their inability to accurately hold the impressed wave shape throughout the frequency band required for audio work.

The gain within the tube itself varies with the design, which accounts for the variation in the numbers and types of tubes that an amplifer contains. Screen grid tubes give an amplification factor of about 50, but due to the type of circuit required for their use actually give considerably less than that in over-results. The average gain of tubes used in audio work is in the neighborhood of 3 to 4. So that our transformer (if we use a 3 to 1 ratio), has raised the voltage impressed on the grid of the tube to 3×6, or 18 volts. Considering the amplification factor of the tube to be 4, the tube itself has raised the voltage 4 times more, or a total of 72 volts.

When losses, inefficiency and other considerations enter into the problem the above is not quite accurate, but it is close enough for a rough approximation as to how the system gives gain. Thus we see that regardless of frequency the output of the tube, so long as it is within the band that the transformers will pass faithfully, is going to have the same wave shape as the impressed wave and of much greater amplitude. One tube and its associate coupling is known as a *stage of amplification.*

Gain vs. Delivered Energy

A very common error is that of confusing the gain of an amplifier with the amount of energy it is capable of delivering. For example, there is virtually as much gain in a photo electric cell amplifier as there is in a large theatre amplifier, but the power outputs are as far apart as are the outputs of a magnetic pickup and a photo electric cell. As a matter of fact, the only purpose served by the photo electric cell amplifier is that of raising the output of the cell to the level of the output of a magnetic type pickup.

Thus, we have tubes with low current consumption in both filament and plate, but which have a high amplification factor to raise the voltage of the outputs from microvolts (millionths of a volt), to the 50 or 60 volts necessary to satisfactorily operate the power tubes that finally deliver the energy to the speakers in the form of heavy current changes at comparatively low voltages.

Efficiency Considerations

The number of stages required, the types of tubes to use, and the types of coupling between stages is dependent upon the task which has to be performed and, let us not forget, the amount of skill and money available. The results obtained are contingent upon the same considerations. Whether or not an amplifier will faithfully reproduce a change in voltage of one microvolt (0.000,001) and raise it to a value of possible 100 volts at any frequency within the audible range constitutes the problem. There is not such an amplifier in existence today that will do it that lends itself to commercial application. The human ear is far from perfect and engineers are given a fair range of error to work in. Some amplifiers are, of course, inferior to others. There is room for improvement in the best and it is the hope of all engineers that they may some day build "The Perfect Amplifier."

Additional couplings with the explanation of their functions and advantages together with amplifier troubles will be put in terms that are understandable by all of us in the next installment issue.

(To be Continued)

Remote Volume Control

THE presentation of "Rio Rita" by Radio Pictures, Inc., at the Earl Carroll Theatre, Broadway, New York, was marked by a radical departure from custom in the matter of regulating the volume of the accompanying sound. Volume control on this picture was transferred from the projection room to a spot on the orchestra floor, and an extra man (at road scale), was delegated to the work of manipulating a special fader which had been installed. This extra man did nothing but control the volume, as did his alternate on the second shift. The results obtained with this presentation are understood to have met with glowing approval by Radio Pictures officials, and it is not unlikely that the same course will be followed in subsequent "big picture" runs.

Writing in a recent issue of *Zit's* theatrical weekly, Epes W. Sargent had the following to say anent this innovation in sound picture presentation:

" . . . Because the motion picture always has been projected, the mistake has been made of expecting the sound to come from the same source. Two men may be employed, but they work in the projection room. Most of them are given a rehearsal of a new show, and are provided with the fader numbers required in an empty house. They are supposed to change these numbers as the house fills, requiring an amplification of the volume to meet the increased sound absorption.

Selective Picture Taste

"It is very proper to entrust the projectionist with the mechanical reproduction of sound. This lies in his province . . . but it is somewhat stupid to expect him to give the best sound reproduction while he stays cooped up in the small room, judging the effect in the auditorium by the often indifferent tone coming from the monitor horn . . .

"We are approaching the point where the public is becoming selective . . . It must be good sound, with an avoidance of breaks in volume, interruptions in continuity, and coarseness of tone. . . .

"It must be delivered to the auditorium properly, and this cannot intelligently be done from the projection room. The fading should be done by remote control from the auditorium. It may mean one or perhaps two additional salaries, but the additional expense is worth while."

New International Charter

At the recent meeting of the Executive Council of the American Federation of Labor, held at the Royal York Hotel, Toronto, Canada, International President Canavan appeared before the Council and requested that the title of the organization be charged from the International Alliance of Theatrical Stage Employes to the International Alliance of Theatrical Stage Employes and Moving Picture Machine Operators of the United States and Canada.

Under date of November 8th, 1929, Secretary Frank Morrison advised that the request for a change of title of the organization had been favorably acted upon by the Executive Council of the American Federation of Labor. The new charter has been issued and the records of the American Federation of Labor changed accordingly.

The New Super Simplex

By HERBERT GRIFFIN

PROJECTORS are the heart of any projection room, sound reproducing apparatus notwithstanding, thus any important advance by projector manufacturers is of paramount interest to everyone in the projection field. A real contribution to projection engineering has just been made by International Projector Corp. with the introduction of the new Super Simplex projector. This development embodies many suggestions by projectionists, as is usual with any important projection equipment improvement. Herbert Griffin, who was actively identified with the plans for and production of this new Simplex, contributes in the following pages a detailed description of this new apparatus.—THE EDITOR.

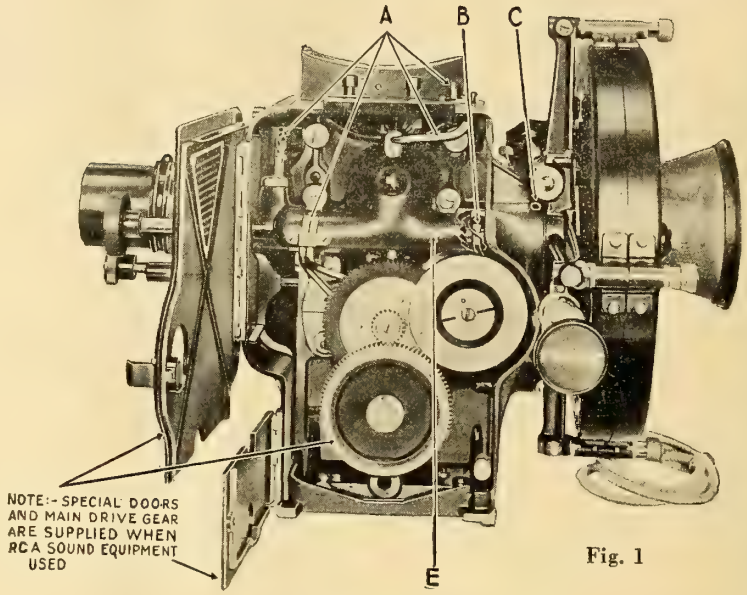


Fig. 1

Oiling System

The simplest and yet most efficient oiling system now forms part of the Super Simplex main frame assembly. All bearings in the frame are now reached by means of oil tubes conveniently located on the gear case side of the mechanism, see A, Fig. 1. There is but one bearing which has a direct oil hole on this side of the apparatus; this oil hole is for the lubrication of the rear bearing of the shutter shaft and is shown at C, Fig. 1. Do not overlook this oil hole when oiling the mechanism.

All oil tubes but one are plainly visible upon opening the mechanism door on the gear enclosure side and no further instruction with regard to them is necessary, except to state that all oil tubes which are immediately visible should receive oil at least once a day. The visible oil tubes have within them a wick which reaches the bearing and a few drops placed within the tubes each day will be more than sufficient to take care of proper lubrication. Be careful to note that one of these tubes comes out through the top of the mechanism.

Oiling Intermittent Casing

The one oil tube which is not immediately visible is that which carries oil directly into the intermittent case and there is no wick in this particular tube. The procedure for placing oil in the intermittent casing is as follows:

(a) Set the framing handle to the position which brings the red line on the oil sight to a horizontal position.

(b) In the shutter shaft support casting, E, Fig. 1, just above the flywheel of the intermittent movement, there will be found a window or hole milled through the casting through which can be seen a portion of the shutter shaft. Just in front of the shutter shaft is the oil tube, B, Fig. 1, leading to the intermittent casing. This oil tube can be reached in one position only—this position is obtained by moving the framing handle as before directed. Enough oil should be inserted through this tube to bring the level in the oil case up to the red sight line, and no more.

[NOTE: The above instructions with regard to the level of the oil in the intermittent case apply only when the machine is level. Judgment must be used by the projectionist when the projector is operating at an angle.]

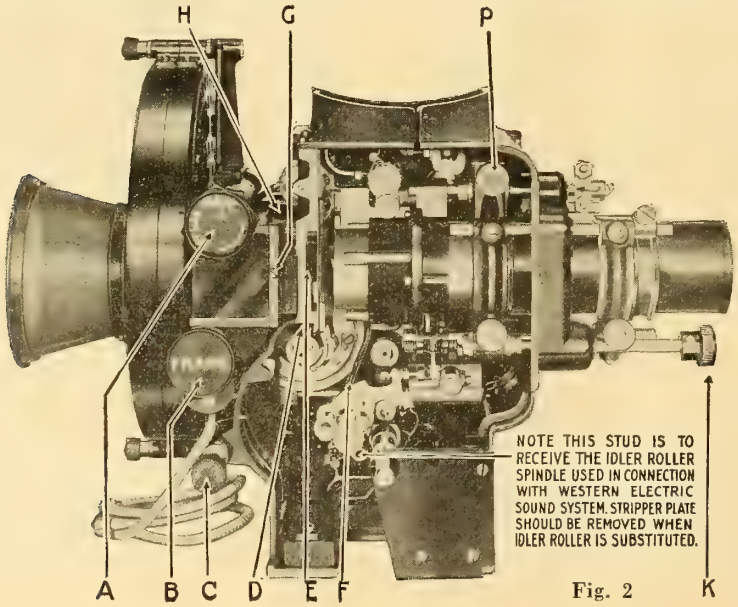


Fig. 2

There are other minor oil holes which should receive oil occasionally, two which provide lubrication to the bearings of the "Film Gate" opening shaft, one which provides lubrication to the rear bearing of the "Frame" shaft and two which provide lubrication to the bearing of the "Shutter Adjusting Shaft." The latter oil holes will be found beneath the framing lamp assembly. The only other oil hole on the mechanism is the one supplying oil to the outer bearing of the intermittent sprocket and this bearing is oiled through the ball oilcap, D, Fig. 2, in exactly the same manner as in the old-type Simplex mechanism with double-bearing movement. Of course, a small drop of oil should occasionally be placed on all slipping and sliding parts in order that they may work freely at all times and also on the gear

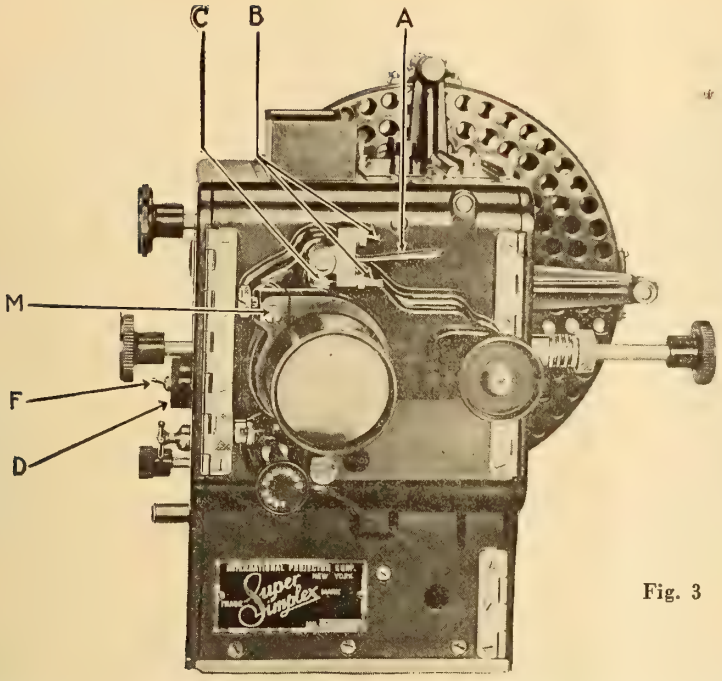


Fig. 3

teeth so that the mechanism may operate smoothly.

Aperture and Picture Centering Device

The Super Simplex is supplied with the vertical sliding aperture plate in which are two standard apertures, one having the standard dimensions for straight silent film projection (.906 x .6795) and the other having standard dimensions for sound film projection (.800 x .6795), or the proportional aperture (.800 x .607), for the projection of sound film to give a screen picture of the same dimensions as obtained with the standard silent projection aperture. With the use of this latter aperture it is necessary to change to shorter focal length lenses and this can be readily and quickly done as explained hereafter under MOUNTING LENSES. *It is also possible to furnish Super Simplex Projectors with the lateral type of sliding aperture in which all types of apertures may be used interchangeably if desired.*

Aperture Plate

The aperture plate, E, Fig. 2, slides vertically behind the film tracks on the film trap. In its upper position it carries the standard silent film aperture. When slipped into the lower position it carries the standard sound film aperture or the standard proportional aperture, depending on which was ordered with the projector. When using the stand sound film aperture or the proportional aperture it is obvious that the lens mount with relation to the center of the aperture is off center, due to the masking of the sound track and, therefore, throws the picture to one side on the screen.

We have designed and built into this projector an ideal method of correcting this condition. On the front and top of the lens mount, outside of the mechanism, see Fig. 3, will be found a lever, A, which may be thrown laterally from left to right. In the position shown, the lens is accurately centered on the standard or proportional sound film aperture, and thrown over to the left position it will be centered for the standard silent or disc aperture. Stops B, Fig. 3, are provided on this adjustment so that the length of its throw may be pre-determined in order that the lens may also come into the correct relation with the projection apertures and the projected picture; these stops fetch up against the stationary stop shaft, C.

Ideal results are secured with this arrangement when using the proportional aperture, because when this aperture is used and a change made to the correct shorter focal length lens, a picture of the same proportions as that projected through the silent film aperture is projected to the screen, and by simply moving the lens centering lever to its correct position no further change is necessary on the stage, such as sliding in tabs or masks. Just within the glass door of the mechanism in the upper right-hand corner, see P, Figs. 2 and 5, will be found a lens holder lock screw. This screw is attached to a clamp provided in order that the lens centering lever may, if desired, be locked in fixed position and also to apply a slight tension that eliminates vibration of the lens centering unit.

New Revolving Shutter

Great improvements in shutter design have been incorporated in this shutter. Its extremely large diameter provides for a greatly increased screen illumination and, because of its position with relation to the lamphouse and aperture, it greatly reduces the heat at the aperture, operating as it does between the light source and the film. In addition to this, the shutter is so designed that it directs a strong blast of cool air over the entire front of the mechanism and particularly into the aperture, so that the cooling effect obtained during its operation reduces the heat at the aperture approximately seventy-five per cent. over the older types of equipment. It will be appreciated that this is of utmost importance when projecting sound film because it reaches the sound projection aperture in an undistorted condition. In addition to this tremendous advantage, the shutter blades are vignetted so that a pronounced dissolving effect is obtained while the intermittent movement is in operation and when the cut-off blade passes through the light beam.

The shutter construction is shown in Fig. 4. Very little instruction is needed with regard to the new shutter inasmuch as the method to be followed in setting it is exactly the same as that on the old-type Simplex, viz., bring the intermittent sprocket from rest down two teeth, using the lower end of the film shoes as a guide; then set the center of the shutter on the

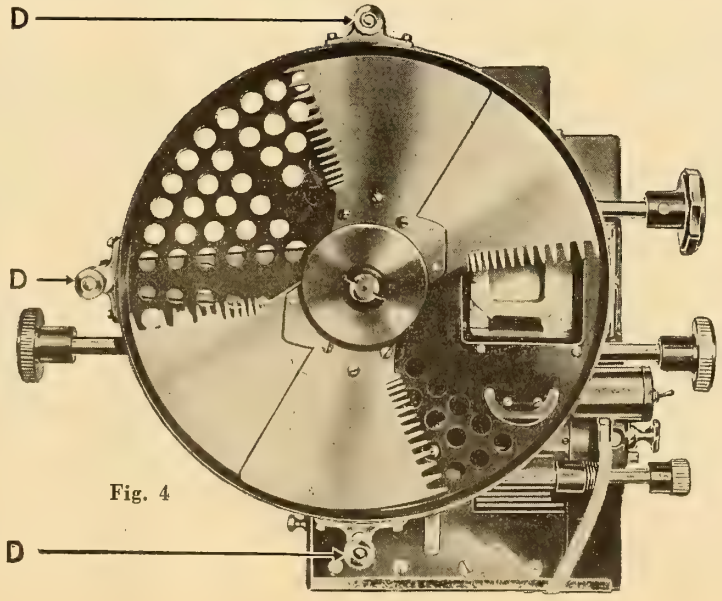


Fig. 4

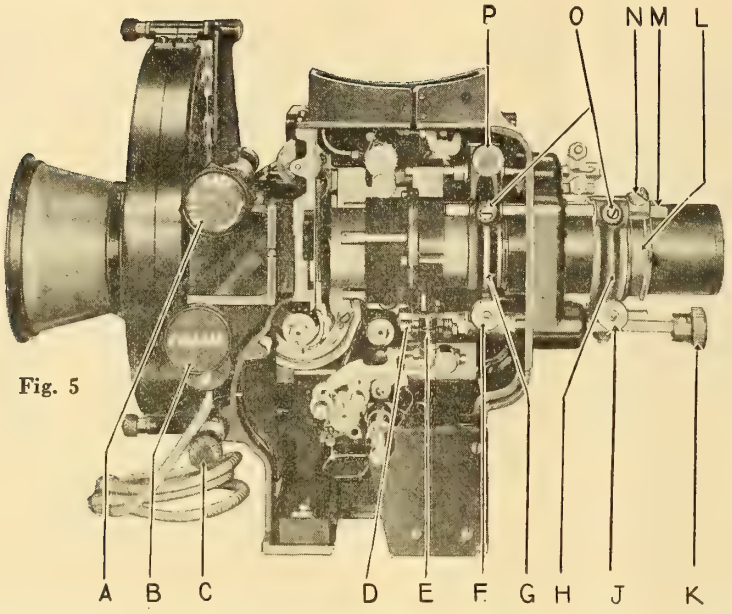


Fig. 5

optical axis, locking it in this position. Care should be taken, of course, to see that the throw of the shutter adjusting screw C, Fig. 2 is set centrally in order that the shutter may be adjusted in both directions if it is not set at exactly the proper position on the shaft. The entire shutter may be exposed by removing the front shutter guard. This is accomplished by simply removing the three nuts and washers D, Fig. 4, and slipping the front shutter guard from its supporting studs.

Eye Shield

The eye shield on the Super Simplex has been so designed to protect the projectionist's eyes entirely from the bright rays from the spot at the aperture. This eye shield is an entirely enclosed device and the colored glass therein may be readily removed for cleaning by loosening screw G, Fig. 2. This eye shield together with the framing and threading lamp are attached by means of screws to the front section of the shutter guard. A slot is provided in the eye shield assembly just behind the aperture, see H, Fig. 2, so that change-over be readily adapted.

Threading and Framing Lamp

An excellent threading and framing lamp has been provided and is mounted below the eye shield assembly, see D, Fig. 3. This lamp directs a strong beam of light up behind the eye shield to the aperture and by this means it is possible for the projectionist to place the film in frame readily while threading the projector. A small switch is provided, F, Fig. 3, by means of which the lamp may be thrown on or off at will, and four feet of armored cable is supplied for connecting the framing lamp assembly to any convenient source of 110-volt devices using an aperture cut-off may supply.

The lamp used in the framing lamp assembly is of special design and is of 10-watt capacity operating at 110 volts. Should it become necessary to replace this lamp, loosen screws which hold switch assembly and lamp socket in lacquered barrel; the entire assembly may then be removed and lamp readily replaced.

Gate Opening, Framing and Shutter Adjusting Knobs

These knobs are plainly visible on the projector and very little need be said with regard to their operation. The film gate knob, A, Figs. 2 and 5, controls both the film gate latch and the gate opening device, and it is turned about a quarter turn to the left as indicated by the arrow thereon to open the gate. When the gate is opened, upon being released by lever F, Fig. 2, it both closes and latches readily. *When the gate is closed it should be closed gently and a slight pressure of the finger given it in order to make sure that it latches properly.* The framing handle B, Figs. 2 and 5, is so mounted upon the shaft that when the word "Frame" is read in a horizontal position, as indicated in Figs. 2 and 5, the framing device is centrally located, allowing approximately the same throw to right and left for framing purposes.

The shutter adjusting knob, C, Figs. 2 and 5, is connected through the gear train and shafts to the shutter shaft and turning it in either direction will revolve the shutter shaft to the right or left respectively, so that the shutter may be accurately set with the projector in operation after it has been temporarily set and locked on the shutter side. Care should be taken to see that an equal amount of throw is allowed in the shutter adjusting mechanism when the shutter is locked upon the shaft.

The lens focusing knob, K, Figs. 2 and 5, projects out through the front of the mechanism and is of the micrometer type. One complete turn of this knob moves the lens mount forward or backward approximately .040", depending upon the direction of its rotation.

Lens Mount

THE lens mount is so constructed that it will rigidly support any type of lens having dimensions now established by the Standards Committee of the Society of Motion Picture Engineers; these call for an outside barrel diameter on the series 2 lens of 2-25/32". We will confine our attention for the moment strictly to lenses of the series 2 or No. 2 type, and lenses of the series 1 or quarter size type will be treated later.

The lenses are held firmly in place by means of two lens clamps, one within the projector mechanism, G, Fig. 5, and one on the outside on front of the mechanism, see H, Fig. 5. The lens mount is made to standard dimensions, as above mentioned, and will take any standard Bausch & Lomb series 2, Gundlach half-size, Snaplite half-size, Ilex, and Solex lens. It will also accommodate other lenses of American manufacture having standard dimensions. Half-size Ross lenses may also be accommodated but it will be found that in many focal lengths the large barrel diameter, see K, Fig. 6, is several thousandths of an inch below the American standard,

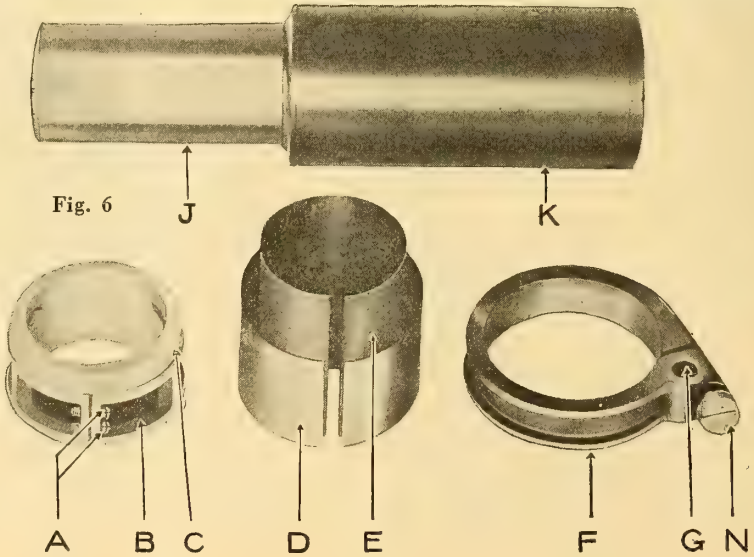


Fig. 6

and where this discrepancy is discovered it will be necessary sometimes to use shims similar to that shown at D, Fig. 6, in the front clamp H, Fig. 5. Two of these shims are supplied with each Super Simplex mechanism, one having a thickness of .005" and the other .010". However, one or both of these shims will bring the off standard dimension of these lenses up to standard. It may be interesting to note that the manufacturers of Ross lenses are now making all their outside barrel dimensions the equivalent of the American standard.

With series 2, or half-size lenses of various focal lengths, it will be necessary to use especially designed adapters on the rear element so that the lens may be properly accommodated in the rear lens clamp, G, Fig. 5, and complete data with regard to these adapters will appear in these columns next month.

Mounting Lenses

When setting lenses in the Super Simplex lens mount the following procedure must be observed: By turning the lens focusing knob, K, Fig. 5, set the focusing nut E, Fig. 5, centrally on the focusing thread D, Fig. 5. Loosen the lens clamp screws F and J, Fig. 5. Slip the rear lens adapter B, Fig. 6 (if one is necessary), over the rear combination lens without clamping it on the barrel, as shown in Fig. 7. Slip the lens in through the front of the lens mount and bring it into approximate focus by sliding it back and forth in the mount. When in focus, slightly tighten the front lens clamp screw, J, Fig. 5, so that the lens will not slip. Slip the rear lens adapter B, Fig. 7, along the lens until it centers in the rear lens clamp G, Fig. 5. Loosen the front lens clamp screw J, Fig. 5, and carefully remove the lens. Tighten the clamp screws A, Fig. 6, so that adapter will then be tightly clamped on the rear lens combination.

The lens is then permanently assembled for future use and may be accurately focused by the focusing knob in the regular way. As before mentioned, with some Ross lenses it may be necessary to shim them up in order to bring them up to the standard diameter to clamp them in the front lens clamp H, Fig. 5, and the shims provided should be used for this purpose.

With all Ross lenses there is provided by the manufacturers a shim shown at E, Fig. 6. *This shim must always be used in connection with the adapter B, Fig. 6. The length of this shim should be reduced so that it does not project beyond the adapter B, Figs. 6 and 7, or interference will be experienced between the shim and the lens mount.* This applies to both large and small diameter Ross lenses.

Series 1 and Quarter-Size Lenses

Series 1, and quarter size lenses of all makes, may be readily accommodated in the lens mount by the use of adapters especially made for them. With lenses of this type it is necessary to use an adapter similar to that shown at B, Fig. 6. After selecting the correct adapter, slip it over the series 1 or quarter size lens with the threaded portion towards the screen. Select a half size lens tube and screw it tightly on the half size adapter. Your series 1 or quarter-size lens will now have the appearance of a half size lens. Do not at this time clamp the adapter tightly on the lens. Slip the lens, as above assembled, into the mount as set forth for half size lenses, seating the half size adapter B, Fig. 6, under the rear lens clamp G, Fig. 5, and gently lock clamp screws F and J, Fig. 5. The series 1 or quarter size lens may be pushed back and forth in its adapter B, Fig. 6, until it comes into approximate focus. The entire lens should now be removed and the two clamp screws A, Fig. 6, in the adapter tightened solidly on the lens. Insert the lens in the mount in the regular way, tighten screws F and J and focus accurately by turning lens focusing knob K, Fig. 5. Due to the many different designs of lenses it is necessary to select the correct adapters for use in connection with them.

Fixed Focus Clamp

In theatres where proportional size aperture plates or effect masks are used, it is necessary of course to quickly change lenses from one focal length to another, and it is essential that each and every lens used in this connection be absolutely in focus without adjustment on the part of the projectionist when the change is made. Where it is desired to change lenses quickly from one focal length to another this is admirably taken care of by means of an auxiliary lens clamp L, Figs. 5 and 7, which clamps to the lens proper by means of screw N. After the lens is sharply focused, as previously described, this auxiliary lens clamp is simply slipped over the front end of the lens barrel and brought tightly against the front lens clamp as shown at L, Fig. 5, and securely locked on the lens barrel at this point.

It is obvious, therefore, that after this is done any number of lenses once focused and equipped with this fixed focus clamp may be removed and replaced at will in a small fraction of time, and will always remain in focus.

In order to insure that the lens will always be in the same position with regard to rotation, means have been provided on the auxiliary clamp to always locate the lens in the same position. At G, Fig. 6, it will be noted that there is a hole drilled in this clamp; this hole is so placed that the clamp, when attached to the lens, may slip over the shaft M, Figs. 3 and 5, as will be readily seen upon examining Fig. 3, which shows a lens in position as above described. The lens will always be not only in focus but in the same position rotationally. If shaft M, Figs. 3 and 5, does not project far enough beyond the clamp, H, Fig. 5, loosen the two screws O, Fig. 5, and slip the shaft M forward until it projects far enough to receive the fixed focus clamp L, Fig. 5; then securely tighten the two screws O, Fig. 5. It then takes a small fraction of time to change lenses in this manner and, of course, care should be taken always to tighten the lens clamp screws F and J when lenses are inserted in the clamps. A half size lens with rear adapter and fixed focus clamp is shown assembled in Fig. 7.

To take full advantage of the lens mount it will be necessary, where the lens already in use is too short to reach the front clamp and be quickly handled, to add a threaded tubing of standard outside dimensions. In future these extension barrels will form part of the lenses, but where lenses are already in use these extension barrels may be obtained from the National Theatre Supply Co. or the International Projector Corp. The type of lens used, of course, must be stated inasmuch as the threads differ on various makes. *When ordering Super Simplex mechanisms the focal length and make of lens should be specified so that correct adapters for Super Simplex lens mounts may be included in shipment.* Where Super Simplex projectors are ordered for new installations the size of screen and length of throw should be stated so that the lens manufacturers may furnish lenses properly adapted to fit the mounts. To take advantage fully of the excellent feature of the fixed focus clamp where quick lens changes are necessary, the front end of the lens must be located 10½" from the film line, and adapter collars may be procured to obtain this length.

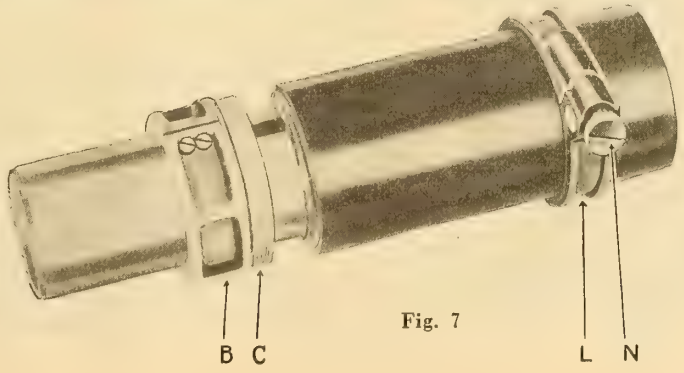


Fig. 7

New Advances in the Art

New Pickup Embodies Many Novel Features

IN the selection of an electro-magnetic pickup for sound picture application the consideration must go further than those ordinarily involved in determining the desirable features in an instrument of this kind. It goes without saying that a pickup to be good for any form of application must deliver a realism of tone throughout the entire chromatic scale and, in the nature of electrical reproduction of records, a power and brilliance surpassing that of the old acoustic form become natural complements.

Beyond power, quality and brilliance, however, pickups for sound pictures have special and practical considerations to meet that it might be said become almost paramount.

Efficiency Requisites

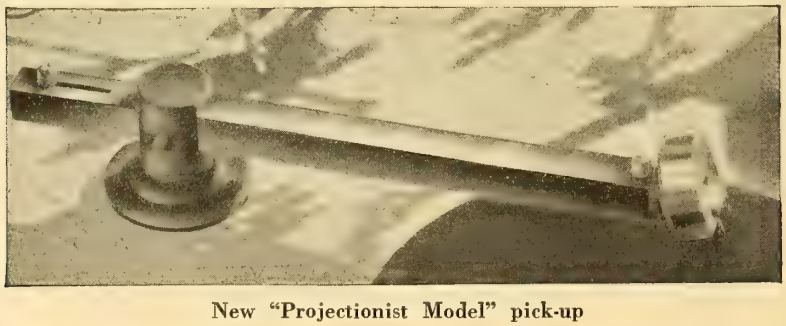
These special considerations can be summarized as (1) dependability of performance; (2) a sharpness in speech enunciation; (3) electrical and mechanical design and construction that permits ready substitution of units to meet emergency conditions; (4) minimizing record wear and avoidance of groove jumping; (5) an arm design and construction that is especially adapted to the reproduction of 33 1-3 recordings.

It was with these special and practical considerations of projection room application, the Presto Machine Co. evolved their "Projectionist model" pickup. To insure dependability of performance the method of suspending the armature is such as to eliminate collapse or freezing. A sharpness in speech enunciation is accomplished by a special form of armature and pole piece construction. Instantly replacable units, mechanically and electrically, without the need of tools, is accomplished by a simple thumb screw and pin jack connection.

Minimize Record Wear

To reduce record wear to the minimum vibratory flexibility is provided and in order to prevent the possibility of jumping grooves the vertical motion is controlled by a rugged pivotal bearing at as great a longitudinal distance from the needle point as is practical and in the closest practical plane thereto. A ballbearing base arm with pivot construction of smooth action and permanent alignment sufficiently rugged to withstand rough professional use, with adjustable needle weight, complete the special features that should be sought by equipment manufacturers and projectionists.

In selecting a pickup it is, of course, necessary to know the impedance of the amplifier with which it is to be used, inasmuch as maximum results can only be accomplished by a close match of the pickup and amplifier impedance.



New "Projectionist Model" pick-up

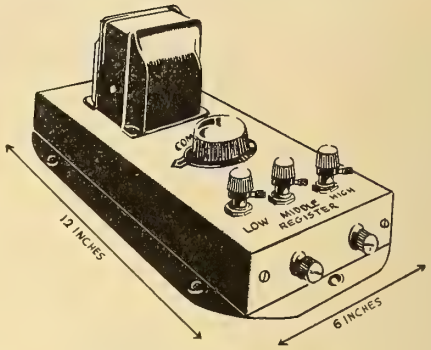
Audible Frequency Selector for Projection Room

A NEW instrument enabling the projectionist to maintain control over the quality of reproduction in his theatre, for either film or disc, has been developed by Simplimus, Inc., and will be marketed under the name of the SAF 3 Mixer. The instrument operates on the following principle. (1). All sounds reproduced by the speakers are electrical frequencies of different periods. These audible frequencies range from about 30 to 5000 and more per second. Therefore; (2) Most forms of defective reproduction, i.e., drummy, barrelly music, muffled unintelligible speech, tinny, shrilly notes, etc., are due to the presence of unwanted and harmful frequencies in the sound reproduction, consequently. (3) If it is possible to design an instrument that has an absolute control over these electrical frequencies, if this instrument can select and eliminate the unwanted frequencies, and if it can bring out the frequencies that are wanted, the problem of good sound reproduction is solved. This Simplimus has done.

Method of Control

The SAF 3 Mixer is connected between the sound pick-up and the amplifier. All the frequencies from the film or disc pick-up pass through it, and it can be set at the will of the projectionist to accentuate or attenuate and even entirely eliminate certain frequencies in the "mixture" being delivered to the input of the amplifier.

On this instrument are located three switches marked *Low Register*, *Middle Register*, and *High Register*, respectively, in addition to knob marked Compensator. The mixer operates in the following manner: Take a case where the speech is muffled and drummy, the words mushy and indistinct. This is the most common trouble and is due to the over accentuation of the *Lows*, caused by defective recording or poor reproducing equipment. To remedy this case, just throw the switch marked *Low Register*, turn the *Compensator* knob to the right and gradually the *Lows* will disappear, the voice will become more distinct, because the *Highs* which were previously drowned out, will now stand out clear and sharp, pronunciation becomes intelligible and plain, you can hear every "s" and "th" and the consonant sounds.



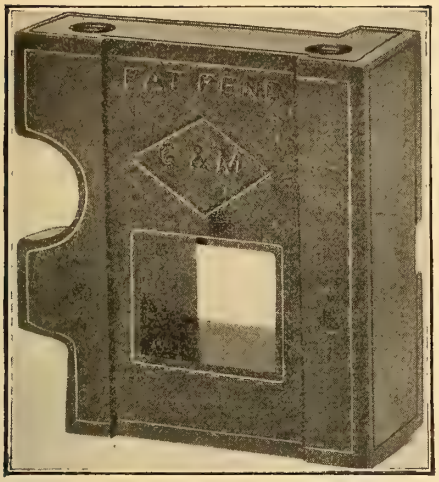
Audible frequency selector

In cases where the theatre is resonant to certain frequencies, this can be remedied in some cases, by attenuating the frequencies which are mostly responsible for the resonance. In most cases speech will be greatly improved by the partial elimination of the *Lows*. If the reproduction of music is too high pitched and tinny, throw the switch marked *High Register* and turn *Compensator* until the right amount of *Highs* has been eliminated, etc. The same also applies to the *Middle Register*.

National Announces Vastly Improved Carbon

AN important advance in the motion picture technical field is reported by the National Carbon Co. research laboratories. A recent announcement by the laboratories states that workers have succeeded in providing a light source in the form of a special carbon arc which has from 30 to 50 per cent greater brilliancy than the sun itself. Practically the last obstacle in the way of successful projection of wide film and stereoscopic motion pictures has been removed, according to the National Carbon announcement, although no technical data is supplied to support this claim.

For years the movie industry has been experimenting on a film giving the stereoscopic effect which would be shown on screens with an area two to



G. & M. Cooling Plate

three times as great as the present screen. Successful projection of this film requires the use of more light than has ever before been used in motion picture projection. Even the brilliancy of sunlight was insufficient for satisfactory projection on a screen of this area and the sources of illumination previously used fell far below this value. Many attempts were made to produce a light of the required intensity and enormous sums were spent on these efforts. The difficulties to be overcome at times seemed insurmountable.

Early New York Showing

Cooperating with the manufacturers, the engineers of National Carbon Company perfected a super-high intensity carbon similar to those made by them for the most powerful government searchlight.

The manufacture of this carbon requires from six to eight weeks. So great is the care required that the raw materials are produced under careful technical supervision in a plant designed and built for that specific purpose. The perfection of these carbons makes the exhibition of the wide stereoscopic film a certainty and it will be only a matter of a few weeks before they will be shown by several New York City theatres.

(Note: Details of this new carbon have been promised in time for the next (March), issue.—Ed.)

G. & M. Cooling Plate

A new cooling plate which has been designed to reduce fire hazards, lengthen the life of film, aid in projecting a sharper picture and give the projectionist a constant check on temperatures is now being marketed by the G. & M. Manufacturing Co., New Britain, Conn.

Single Bronze Casting

These cooling plates are made of a one-piece solid bronze casting and are tested up to 200 pounds hydraulic pressure. The plate is so designed that when attached to the projector it is in direct contact with a large surface of the projector head. By the circulation of cold water through the plate in contact with the film trap approved by numerous municipal the entire projector machine head is kept cool, ranging from 15 to 25 degrees cooler than the room itself. Designed by a projectionist, this plate requires but two screws for permanent installation.

G. & M. cooling plates have been fire departments in Connecticut, and are endorsed by I. J. Hoffman, general manager for Warner Brothers in the New England states. Nominal in price, these plates offer high security value at an unusually low price.

Sound Picture Development in 1930

By C. J. ROSS

Vice-President, RCA Photophone

THE principal factors, I believe, which will make for the greater success of sound in motion picture theatres during 1930 might be summarized as follows:

The wider scope and the much greater entertainment values of talking-motion pictures have completely revolutionized film production. Producers during the past year have learned how best to utilize the new dimension which sound has brought to the motion picture art. Directors have discovered new possibilities in electrical entertainment. Established motion picture stars, instead of finding themselves on the way out, have learned how to become audible on the picture screen. The sound picture has attracted the best artists of the operatic, the legitimate and the vaudeville stage.

Improved Recording

In the synchronization of sight and sound on the screen, the fact still remains that you cannot get more out of a picture than what you have put into it. The best possible system of sound reproduction is no better than the product recorded on film or disc. Many exhibitors during the past year have learned to differentiate between poor recording and poor reproduction. The result is bound to tell in better recording and more discriminating use of sound recording systems.

The avalanche of sound which struck the motion picture industry little more than two years ago brought "bootleg" as well as legitimate apparatus into the field. But the industry has learned that not everything which reproduces sound is good sound equipment.

200 Men at 32 Stations

For 1930, RCA Photophone is establishing a coast-to-coast system of 32 service and spare parts stations under the supervision of a staff of more than 200 trained engineers. Stations will be located in principal cities throughout the country and at all points where speedy and efficient service to theatres in the adjoining territories may be given. As an adjunct to the new system, RCA Photophone will expand the training facilities at its Sound Motion Picture Equipment School in New York, where technically trained men are being initiated into the installation and servicing of RCA Photophone reproducing equipments, preparatory to their taking posts in the service system.



Plant "B" of the Weber Machine Co., Rochester, N. Y. This addition to Syncrodisk home was made necessary by greatly increased volume of business

Demonstrate 3-Grid "Pentode"

A NEW five-element vacuum tube known as the pentode was demonstrated recently in New York by Ernest Kauer, president, and associated engineers of the Ceco Manufacturing Company of Providence, R. I. Its advantages are asserted to be that it is three times as powerful as the screen-grid tube; it will simplify sets, make them more compact, and require fewer tubes. It is called "the greatest advance in radio since the three-element tube was announced in 1906."

Has Three Grids

The engineers at the demonstration saw that the pentode is capable of being utilized practically to its full efficiency. They contend that it will lower manufacturing costs and will decrease maintenance costs for set owners. It differs from the screen-grid bulb chiefly in that another grid has been added. The three-element tube has one grid, while the screen-grid tube has two grids.

"The public has been asking for receiving sets which do not employ so many tubes," said Mr. Kauer. "This development makes it possible to build sets which will satisfy that demand. Bringing, as it is bound to do, more simplicity into radio manufacture and receiver operation and maintenance, it will reduce manufacturing costs, material costs and therefore costs to the radio public. It means fewer tubes per family, but that a great many more families will own receivers.

Greatly Increased Efficiency

"The new tube is a sort of double screen grid, having a screen around the plate, as is the case with the screen grid of the present; also another screen between the control grid and the cathode. The insertion of this second screen permits a greatly increased amplification, three to four times as great as the screen grid."

N. O. Williams, Ceco's chief engineer, said the pentode tube would realize the hopes which were entertained of the so-called screen-grid or four-element tube.

New Circuit Requisite

"The screen grid is a very wonderful tube," Mr. Williams continued, "but the radio industry has not been able to develop a receiving circuit which permits the use of the tube's full efficiency. Nor is such a circuit likely to be developed. There are too many difficulties in the way. The easier method has been to centre research on the development of a tube which would make possible the building of a circuit capable of getting out of the tube all the power and valuable attributes inherent in it. This is what we have done in the case of the pentode."

The pentode will be on the market within five or six weeks in quantity, according to the Ceco Co.

"Still" Photographers Now Under I. A. Jurisdiction

International President William F. Canavan appeared before the Executive Council of the American Federation of Labor at the Royal York Hotel, Toronto, Canada, on October 19th, 1929, and made request for jurisdiction over still photographers employed in motion picture studios in connection with the work of the motion picture cameramen.

Under date of November 7th, 1929, Secretary Frank Morrison of the American Federation of Labor officially advised the General Office that the request for extension of jurisdiction over still photographers employed in motion picture studios in connection with the work of the motion picture cameramen, had been granted by the Executive Council of the American Federation of Labor.

Truvision Grandeur Screen at Roxy Theatre

Following preliminary tests with a standard size Truvision screen, the Roxy Theatre in New York has entered its order for two more Truvision screens for Grandeur (wide) film presentation and has officially adopted this screen as standard projection equipment. The Truvison screen was subjected to exhaustive tests on the quality of picture and sound transmission efficiency, after which the Roxy okayed it as standard.

Make Screen Fireproof

In addition to giving high light value and passing a maximum amount of light, Truvision screens have been made fireproof, an important feature of all sound screens in the light of continued insistence by municipal and State authorities that screens should resist fire and thus reduce the danger of fire backstage to a minimum.

Truvision glass beaded sound screens are merchandised on the basis of brilliance, depth, definition, and third dimension illusion. The Electrical Testing Laboratories report No. 48,114 of January 22, 1930, is available to all who may wish to have an authoritative check on the qualities of this screen. The screen may be washed in ordinary soap and water without losing any of its original brilliancy.

Big Grandeur Production

Preparations are now going forward at the Truvison factory to produce Grandeur size screens on a large production basis.

Chicago Local 110 Gains New Wage Contract

The recent wage scale controversy between the Chicago Exhibitors' Association and Local 110 has been settled with the latter gaining a small advance in wages for its members. The settlement agreed upon has been put in contract form which has two years to run until January 11, 1932. The features of the settlement which was negotiated but a few hours before the old contract expired, follow:

Where operators are paid for time not consumed on schedule extra time may be used for any additional work necessary in the booth including maintenance of batteries on that day. One man to be called with service men on sound equipment on inspection and paid for time worked once a week.

Report Half-Hour Early

Operators shall appear on the job 30 minutes before the advertised starting time to put their equipment in condition for the day's run and do such work as cleaning lenses and equipment and greasing and oiling machines. Twice a week operators shall run 10 minutes past regular closing time without additional compensation.

Overtime caused by breakdown due to the negligence or carelessness of the operator shall not be charged for. Where operator is called to cue film before show one operator to be called.

New Equipment

Any condition arising over the installation of new equipment in the operating room which would in any way change the conditions of the operators shall be discussed by the business manager of the operator's union and the business managers of the exhibitors' associations and if these men cannot make an amicable settlement the wage committees of both organizations will meet to find a solution.

Midnight shows to be paid for at the regular scale up to 12:00 P. M. and double time after 12:00 P. M. All other conditions to remain the same.

W. E. Installations

All weekly records for the installation of Western Electric Sound Systems were shattered when 146 installations were completed the week ending December 28, according to C. W. Bunn, General Sales Manager of Electrical Research Products.

One Every 59 Minutes

The new record establishes an average of one installation every 69 minutes. It tops the previous record of 114 installations during the week of September 21, 1929, an average of one every 87 minutes. Western expects to better this record in 1930.

Everyday Science

P. E. Cell Application

THE teacher will no longer be required to turn on the lights in her schoolroom on dark afternoons or other periods of the day when artificial illumination may be necessary. A small automatic electrical device, developed by research engineers of the General Electric Company, will do this for her. And when the electric lights are no longer required the same device will automatically turn them off again.

The device consists of a small box, about the size of an ordinary radio receiving set. On one end is a small lens, which permits light from the outside to fall upon a photoelectric tube, better known as an "electric eye." This is set for a certain degree of daylight intensity and whenever light from outside falls below this mark, the "electric eye" causes a small relay to switch on the electric lights in the schoolroom. This box is placed near an outside window of the schoolroom and can be easily adjusted to any degree of light intensity desired. An automatic time clock disconnects the apparatus during the hours when school is not in session, thus preventing the lights being turned on automatically at night.

Check on Eye Needs

Teachers with large classes, as is now the rule in most public schools, sometimes forget to turn on the lights when artificial illumination is necessary. In some rooms the teacher's desk may be much nearer a window than some of the seats of pupils in a far corner and she may not realize those pupils in the far corner are perhaps straining their eyes because of insufficient illumination. This new device will relieve the teacher of this responsibility.

Breathing Electricity

The air that human beings breathe is not only electrified but changes hour by hour, almost minute by minute, in the amount and character of electricity which it contains; imperceptibly to human senses, but perhaps with profound effects on mind and body. That atoms in the air may become electrified has long been known to experts.

For several years Professor Fernando Sanford of Stanford University, California, has been keeping regular records of this air electrification. Finally, at the recent meeting of the American Physical Society at Stanford, Mr. Joseph G. Brown reported measurements of what is called the "space charge" of the air, like the similar space charge inside a radio vacuum tube and which may be thought of as the amount of loose electricity in each cubic foot or cubic yard of air.

This space charge may change very rapidly, Mr. Brown has discovered, especially if air currents are rising or falling. Rain storms also affect it, as do winds, cold or hot waves and other weather changes. While Mr. Brown suggests no human applications of these facts, it is possible to suspect that they furnish a clue to some of the mysterious effects of weather on human minds or bodies.

Everybody has experienced apparently causeless exhilarations or depressions in different kinds of weather. Many workings of the human body are known to be electrical. Perhaps changes in the electric "space charge" of the air, hitherto neglected by physicians and biologists, may explain some of these mysteries.

Animal Span of Life

CURRENT stories of long-lived animals are discredited by Prof. A. D. Peacock, of University College, Dundee, Scotland, in a recent tabulation of the greatest recorded ages of all kinds of animals made for the British publication, the Wonders of Animal Life, now being issued in London. For the elephant, usually supposed long to outlive man, the longest authentic record which Professor Peacock has found is 70 years. The maximum attested age for a whale is 40 years.

Only Four Outlast Man

Only four creatures are regularly apt to live longer than men. These are the giant tortoise, for which a 150-year age is unquestionable and 200 years a probability; the German carp, which may live for 150 years; the white-headed vulture, for one which bird there is a record of 118 years; and the eagle, which has an attested record of 104 years. Four other birds, the crow, the parrot, the raven and the Eider duck of the Arctic, may live about as long as long-lived men or women, their maximum records being about 100 years each. Two fish, the salmon and the shark, probably equal this record; and one variety of shell fish, the giant mussel called Tridacna gigas.

Insects Short-Lived

A sea anemone once lived in a zoological laboratory for 66 years. The insect record is held by a fire beetle found alive in a piece of wood which the insect must have entered 37 years before. Ant queens have been known to live for 13 years, but the longest-lived flea is 18 months, the record louse is seven weeks and the housefly, ignoring doubtful cases, lives only 34 days or less.

A toad is known to have lived for 36 years, an alligator for 40 and an eel for 60. The record for a goose is 57 years and for a hen 30 years. Lions and tigers live only about 25 years, but at least one domestic cat lived to be 40. The record age for dogs is 35 years, a horse has lived to be 40 and a cow 25. The shortest animal lives are among the insects, where the winged male of the insect called Stylops may live, Professor Peacock states, for only one to three hours although the female lives for several days.

Most Magnetic Metal Alloy

Several years ago, research engineers of the Bell System Laboratories developed an alloy of nickel and iron which they named "Permalloy," possessing very high magnetic qualities which have proved to be of great value in telephone work, making a marked improvement particularly in long distance transmission through the construction of loading coils much smaller in size and much more effective in operation.

The application of this metal to undersea cable speeded up the transmission of cable messages between five and six times.

Further research has resulted in the development of another alloy which is a combination of iron, nickel and cobalt. A special heat treatment serves to bring out the supermagnetic qualities of this particular alloy, making it much more effective than the original permalloy. The name "perminvar" has been given to this metal. It has what electrical engineers call a constant "permeability" over a wide range of magnetic force, and in addition, the electromagnetic energy loss in carrying this metal through the magnetic cycle is only about one one-hundred-thousandth of the loss occurring in the best grade of magnetic iron.

It is through the use of this new alloy that the hopes of telephone engineers for the construction and operation of a transatlantic telephone-cable are based.

Communications Miracle

Recently in New York City Captain Railey, a friend and supporter of the Byrd Expedition, had a telephone talk with London (3,500 miles) about conditions which might face the ships voyaging to Little America to bring back the explorers from the Antarctic. Finishing his talk, he wrote out a dispatch to Admiral Byrd which called for an answer. A few minutes later *The New York Times* radio station had flashed this message 12,000 miles to the Admiral's Antarctic base.

At that moment the Admiral was flying his plane at least a hundred miles away. His base station sent the

message to the plane, and, while in flight, Admiral Byrd wrote out his answer; it was sent to the base, the base relayed it to *The New York Times* station immediately, and Captain Railey was reading it soon thereafter. The time consumed in the whole process was less than forty-five minutes!

This amazing exploit of the science of communications was described by Correspondent Russell Owen in his dispatch from Antarctica. It was part of the story about the flight to Discovery Inlet. Mr. Owen gave the miracle little space, and it was referred to only in the subheadlines. In this age of wonders the remarkable is taken as a matter of course, and the reading public probably gave the news no particular thought after the morning paper had been finished with. That does not, however, make the whole process, annihilating time and space, less astounding.

Bad Food Cause of Majority of American Ills

One reason why arthritis, heart disease, high blood pressure, chronic stomach trouble and other "business man's" or "society woman's" diseases are now so common in America is not fast living but bad food. So concludes Dr. Lovel Langstroth of San Francisco, in a report just published by the American Medical Association comparing the diets and diseases of 501 selected patients.

Two Classes of Foods

Dr. Langstroth divides foods into two classes, protective and non-protective, distinguished by whether or not they contain plenty of the vitamines, mineral salts and other substances believed to protect the body and keep it in working order. Chief among these protective foods, he reports, are eggs, milk, fruits, vegetables and lettuce, but these made up only 12.1 per cent of the average diet of his 501 patients.

Bread and butter, classed as non-protective foods, made up 16.1 per cent and 17.7 per cent respectively. Meat, also non-protective, accounted for 10.9 per cent. The remaining 43.2 per cent of non-protective foods in the average diet includes sugar, cream, mayonnaise, potatoes, sweet desserts and other foods which are low in vitamines and mineral salts.

Recommended Diet

Comparing the individual diets with the occurrence of what he calls degenerative diseases, including diabetes and the kind of sick headache called migraine, as well as disorders of heart, arteries, digestive system and joints, Dr. Langstroth finds that patients who habitually ate very low percentages of protective foods developed an average of nearly fifty per cent more cases of these diseases than patients who ate plentifully of protective foods. Twelve per cent of the vitamine-rich foods in the average diet is believed to be too low to keep everybody in good health. More eggs, lettuce, milk, fresh fruits and fresh vegetables are indicated for American tables; less bread, butter, meat, potatoes and sweets.

Generator Charts Growth of Electrical Industry

The electric light and power industry in the United States doubles in volume of investment and output of kilowatt hours about once in every six years. The present investment is in excess of ten billion dollars, and the output for 1928 was approximately eighty-eight billion kilowatt hours of electricity.

A striking example of this rapid growth is exemplified by the 160,000 KW. turbine which has recently been put in operation in the Hell Gate Station of the New York Edison Company. This huge unit of 160,000 KW. capacity is equivalent to about 215,000 H. P.

Another unit of the same size will be in operation in a very short time, bringing the present capacity of this station up to 605,000 KW. and making it the world's largest steam generating plant.

One of the striking features of these new units is that they each occupy practically the same space in the station originally intended for a 35,000 KW. generator. In other words, five times as much power is now generated in the same space as was even considered possible five years ago.

Each new unit consists of a high-pressure turbine, direct-connected to a 75,000 KW. generator, and a low-pressure turbine, direct-connected to a 85,000 KW. generator.

The weight of the unit complete is 1,405 tons. In 1903, a 5,000 KW. generator, built by the same company, weighed 160 tons, or 32 tons per thousand kilowatt capacity. The present unit weighs the least per kilowatt of power generator of any built yet.

Contemporary Opinions

OF late we have received so many letters from exhibitors in various stages of irritation, heated resentment, ire and constant unrest that we have come at least to the temporary conclusion that they are entitled to speedy relief and consideration, now that the talkers are with us permanently, from the exchange man that sends them prints and records unfit for use.

Bad Film—Bad Business

Talking pictures are a little bit of hotsy totsy for the exhibitor when they are clicking mechanically and everything is running O.K. but, when in place of ordinary even projection you have a constant rain storm on the screen and instead of pleasing voices and tuneful melody you get from the loud speaker a symphony of squeaks, scratches and air pockets, the effect upon the customer regarding his future and continued patronage is apt to be most discouraging for the exhibitor.

The indictment before us that confronts the exchangeman aforementioned is rather long and consists of several counts. Here are a few: Oily prints—Scratched prints—Prints out of sink—Poor patches—Broken sprocket holes—Old and worn out records, and divers and sundry other abuses too numerous to mention. The above is inserted as hearsay evidence merely as a matter of record.

Synchronized Murder

Seriously, here is a situation that no doubt is a grave problem to nine out of ten small town houses. It is a big enough thought to deserve the immediate attention and consideration of every sales manager and supervising exchange executive in the business. In former days an old print was bad enough, but under the new order of things bad sound from either print or records is nothing short of synchronized murder.—*The Film Daily.*

Five-Day Week Pays

Early returns from the firing line of industry supports organized labor's contention that a five-day week is practical. The Industrial Conference Board, an employer's research agency, sent a questionnaire to executives of 127 companies having the five-day week. The returns, made public, show:

(1) That 68 per cent of the plants had maintained or increased production;

(2) That 75 per cent expressed no complaint at the reduction in hours;

(3) That higher output per hour throughout the week had been maintained;

(4) Attendance and punctuality had improved, and

(5) Morale of the working force was raised.

It is believed too early, however, to measure the effect on production, generally, and to make generalizations. An article in the *American Contractor* for December 7, 1929, by H. H. Fox, vice president, Turner Construction Company, tends to support labor's contention that production had already reached such a pitch of activity as to warrant the introduction of the short work week. This construction company has kept work charts on jobs since 1913. These charts indicate that production started to climb in 1925, and had reached almost a 50 per cent increase by 1929. —*Electrical Workers' Journal.*

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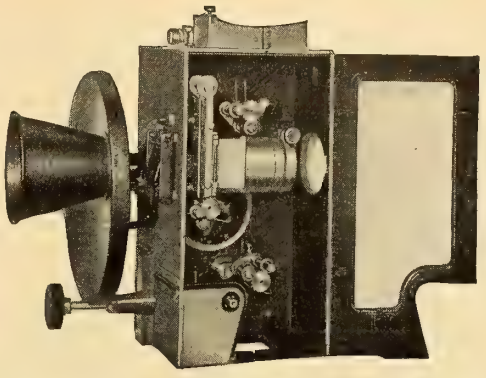
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Film Technical Advances in 1929

ALWAYS of extreme interest to the technical forces of the motion picture industry, the bi-annual report of the Progress Committee of the S. M. P. E. as submitted at the Toronto meeting last Fall presents specific information on projection matters which make the report of exceptional interest to projectionists and those interested in projection work. The report embodies some highly interesting data on general projection room equipment, fire protection work, projection optics, special projection equipment, stereoscopic pictures, screens, and new-type projector developments. The report of this Committee is a valuable contribution to projection bibliography. The report in part follows:

General Projection Equipment

Comparatively few changes have been noted recently in projectors equipped for ordinary motion pictures but many improvements have appeared in connection with projectors for sound films and the newer wide films. A projector of Italian manufacture has, as a novel feature, an automatically adjusted shutter which permits as few as 14 pictures to be projected per second without flicker. A German projector is equipped with spools containing loose centers automatically regulating the film tension, also a shutter which rotates in a ball-shaped housing between the lamp and the gate.

As a change-over signal, it has been suggested that a spring hinged arm be folded over the first few convolutions of the film during rewinding. When the arm is released during projection, it closes the circuit of an electric bell. Another device makes the change-over automatically and also stops the projector and cuts off the light in case of a break.

Types of projectors have been classified into three groups by a committee appointed by the German government. The classes are (1) dangerous and for use in booths only, (2) dangerous only in unusual circumstances, and (3) safe. An advisory council has been established recently which is working in conjunction with the American Projection Society, studying projection conditions in theaters.

Patents related to projectors deal with a great many devices such as pull-down mechanisms, electro-magnetically operated clutches, air cooled lamphouses, etc. Errors in architectural design affecting location of the projection booth are cited to show that greater care should be given by architects in the location and design of this important element in a motion picture theater.

Fire Prevention

Lehmann has written a general article dealing with motion picture film and projectors with relation to fire hazards and predicts that nitrate film will continue in use for some time to come. Detailed specifications of construction materials for projection rooms in Germany have been published. Joachim has published a comprehensive article dealing with shutter design, fire hazards in projection booths and other related subjects. A number of patents deal with various improvements in methods of stopping the projector mechanism in case of fire, closing port holes, the use of heat resisting screens in the path of the light, etc.

Projection Optics

Patents on optical projector systems disclose methods of obtaining maximum illumination with concentrated filament lamps, and a means for projecting a small beam of light upon a douser shutter to permit the projectionist to determine previous to projection the alignment and focus

(*Continued on page* 42)

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FIRE-PROOF SCREEN FOR SOUND

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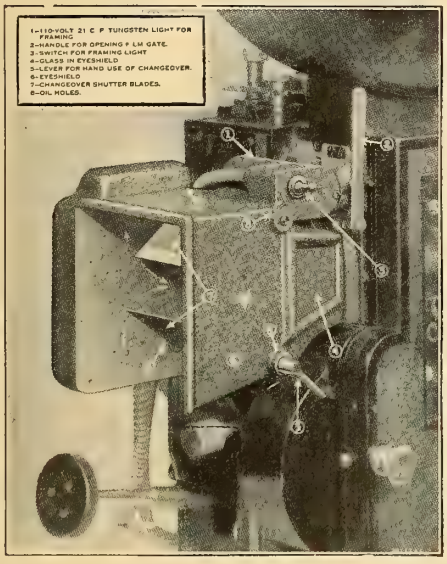
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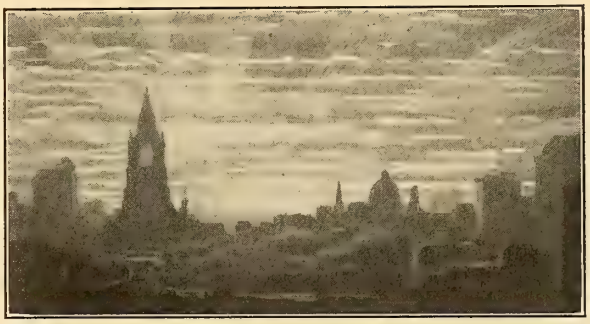
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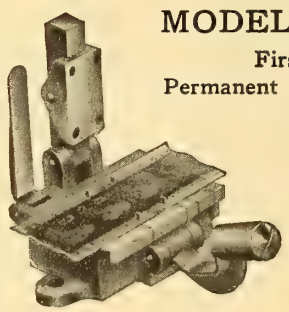
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This Matter of Film Reel Sizes

(*Continued from page* 20)

when short reels are used, and in case of a serious break the additional time would be invaluable.

The last paragraph of Mr. Holz's letter is the focal point of this problem, stressing as it does the most important phase of the motion picture business—audience reaction. As we see it, this matter of film reel size may be expressed as a contest not bebetween producer and projectionist conveniences but between producer convenience and projectionist responsibility to put on a good show. We don't believe we are unfair in stating that the projectionist has proved his case by demonstrating that single reels are impracticable for purposes of putting on a good show; the producer has proved nothing but has simply established the fact that the argument for single reels is based on the rather insecure foundation of personal convenience.

The Old Refrain

It would be too much to expect that anything further will be done about this highly important phase of projection room work. If we know our motion picture business at all, the matter will soon be forgotten, producers will continue to ship out their sound film releases on single reels, projectionists will continue to cut and join single reels, producers will continue to protest this damage to their property and projectionists will continue to ignore these protests. All in all, this disagreement will be permitted to lag on until it finally ties itself into the conventional knots which preclude any possibility of settlement and which are characteristic of all motion picture technical problems.

We should like to have the foregoing prophecy knocked into a cocked hat, but we doubt that it will be. Is there no one who will provide us with this pleasant surprise?

More Opinions:

Sir:—In your December issue you published a communication from F. P. Broadbent on the matter of reels. Mr. Broadbent mentions the fact that "doubling up" and subsequent cutting or breaking-up of a 2,000-foot reel is ruinous to the film. He goes on to say: "In some cases the sound record runs on past the last picture frame, and then we are faced with the choice of cutting off that stretch of sound record (dialogue, perhaps), or having our screen go dark while the sound is permitted to run." Evidently Mr. Broadbent has forgotten the fact that in a Movietone print the dialogue is 14½" in advance of the frame with which it is in synchrony. Therefore, I cannot see the necessity for

allowing a screen to remain dark in order to allow dialogue to run to its completion.

While as I realize that this angle is entirely irrelevant to the main points developed by Mr. Broadbent, it might be wise to publish this for the benefit of those who may be laboring under a misapprehension as a result of the statement quoted.—WALTER SILVER, Brooklyn, N. Y.

Sir:—I, like the great majority, agree that the continued splicing of film impairs synchronization to a large extent. I feel that a vast improvement over present practices could be effected by the use of double reels. In changing over from the outgoing to the incoming projector it is very difficult to cut the former on the last frame of the reel and at the same time catch the incoming projector on the first frame. It can be done, of course, but many times the sequence leader shows on the screen. Even if such an accurate changeover could be made, the sound track registers 14½" below the aperture, so there would be no sound for that fractional time used in changing over, particularly when the ending and beginning of both reels are synchronized, as often happens. I suggest that all exchanges send film out in double reels.—S. SANTORELLI, Morristown, N. J.

New Protective Film Process

Essem Laboratories, Washington, D. C., has closed with M-G-M and Universal whereby these companies will use Perfexit, protective film process. The two companies will process about 6,000,000 feet a week under this system. Deals for the process are pending with a number of other major companies.

The coating does not increase the thickness of the film, the company points out. Instead the solution is entirely absorbed by the film and makes the film more pliable, retards shrinkage and buckling, extends its life and is humidity-proof and scratch-proof. One result of the process is that it holds the gelatine in status quo. The solution is fireproof and will extinguish a lighted match thrown into it, according to company tests.

The solution is applied by an automatic machine capable of processing at any rate of speed up to 10,000 feet an hour. In other words a machine occupying a space of six inches by four feet of floor space will process at the mentioned rate. This process can be applied in combination with, or independent of, the drying cabinet in laboratories.

The process is especially of value in connection with color and wide film, according to the company, and broad and valuable claims have been granted on the process. Dr. L. L. Steele, formerly of the Bureau of Standards, and inventor of the process, is consulting chemist.

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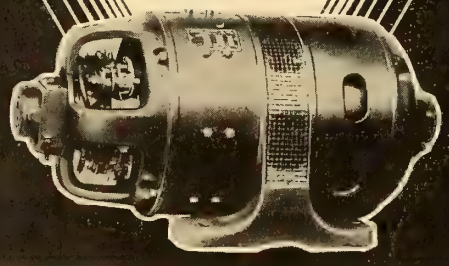
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Installing Super-Lite Lens

Instructions for installing the bifocal Super-Lite projection lens recently introduced by Projection Optics Co. of Rochester, N. Y., as supplied by that company are as follows:

For Silent Film

1st—Turn ring on mount until the optical system is fully extended. This is the correct E. F. for silent film.

2nd—Install lens in machine and revolve entire mount until picture moves over to the extreme right. Then focus sharp on screen and clamp tight in machine.

For Sound Film

3rd—Now reverse the turn with the ring and the system will increase the size of picture and at the same time move the picture over to the left, while the right side of the picture practically remains stationary.

Focusing Picture

4th—A little practice by the projectionist with the shifting movement of picture will enable him to get the picture to fit in the screen for both silent and sound film, as it will require a little experience with this system to get the eccentric movement to work perfectly.

If picture is focused sharp on one extreme and not on the other, a slight turn of the focus movement on machine will correct it instantly.

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Film Technical Advances In 1929

(*Continued from page* 38)

for homogeneous screen illumination. Patzell has discussed the theory and practice of projection light sources, particularly mirror arcs.

Wide Film Advances

The industry is rapidly adapting itself to sound film projection and it is predicted that over 9,000 houses will be equipped for handling one or more types of sound films by January, 1930.

For the projection of Fox Grandeur pictures at the Gaiety, New York, which opened during September 1929, a new projector was used built especially to accommodate the 70 mm. film. It incorporated a high intensity arc consuming 150 amperes for a 70 foot throw onto the 17 feet by 35 feet screen. Special lenses were necessary to accommodate the large screen and a new type of carbon arc was used which will take an amperage as high as 250, considered to be necessary for larger houses.

Interchangeability is a feature of several new projectors equipped for sound projection. One projector is designed in three models, sound-on-film, sound-on-disc, or both and if one of the first two types are purchased, the other may be added later. Several firms are manufacturing sound equipment for attachment to standard projectors. Features of the Royal Amplitone are a high pedestal for the disc assembly permitting easier handling of this type of equipment, freedom from turntable flutter, and a locked optical device for the sound-on-film assembly. A curved sound gate is used by Tobis-Klangfilm to prevent film buckling.

New Reproducer

New apparatus for playing disc records continues to be announced. Filmophone is stated to permit interruption of the sound at any predetermined point and the Electrocord consists of a well-balanced turntable for use in small halls. RCA Photophone have announced a dual system unit for use in theaters seating 500 or less.

A reproducer employing the condenser principle has been described. It consists of a slotted aluminum grid which acts as one plate and a thin layer of gold or aluminum leaf glued to a rubber diaphragm serves as the other condenser plate. Several of these grids are attached in the rear of the projection screen. A hydraulic lift is now used for the stage mounting of loud speaker horns. A segmented cardboard disc has been announced which can be used to synchronize the picture with a disc record. Fader control from the auditorium is possible with an installation used

by M-G-M for road shows in the larger neighborhood theaters.

A committee of technicians has undertaken an investigation to draw up a set of standards for camera and projector apertures, according to a report from the Academy. A preliminary survey indicates that the majority of theaters showing sound-on-film pictures are using a screen that is nearly opaque. Sliding masks are sometimes used alone or in conjunction with a horizontally movable lens mount. Sometimes a lens of lower focal length is used and an undersized aperture plate thus restoring the 3 by 4 proportion but at a loss of some of the picture. A recent report states that all the large producers on the Pacific Coast have agreed to adopt at once the recommendations of the joint committee of this Society and the Academy of Motion Picture Arts and Sciences providing for the use of a standard aperture of one size in all cameras. Numerous patents have been granted an improvement in sound projection apparatus and accessories.

Third Dimension

Since the public showing of the "Teleview" in New York City in 1922, there have been no further development of commercial interest in stereoscopic pictures until the past summer when wide pictures were introduced. Both Fox Grandeur and the Spoor-Berggren systems are claimed to give the illusion of depth but those who have seen them state it is only a fair illusion. Special lens systems are used in the recording cameras. A compressed air control is used in the Spoor-Berggren projector to hold the 56 mm. film flat. Ritterath is inclined to believe the secret of stereoscopic motion pictures lies in the use of a composite screen rather than special cameras or projectors. A relatively complicated method of stereomotion pictures having severe practical limitations has been described in a paper by Ives, before the Optical Society of America. A few patents related to stereoscopic motion pictures have been granted.

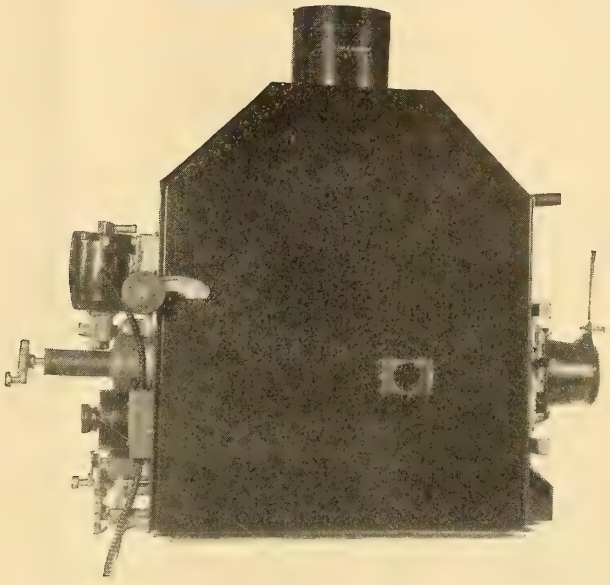
Optical Projectors

Efforts continue to perfect non-intermittent projectors, most of the published results coming from Germany. The most successful of the commercial models, the Mechau projector has been further improved in Model 4, a description of which appeared in an issue of Kinotechnik early this year. Burmester and Mechau have prepared a very complete treatise on the mechanical and optical principles underlying this projector. Several German theaters are reported to be using them and an earlier model was installed for a short time at the Capitol, New York, a few years ago.

Thun has published a paper on projection with optical compensation and

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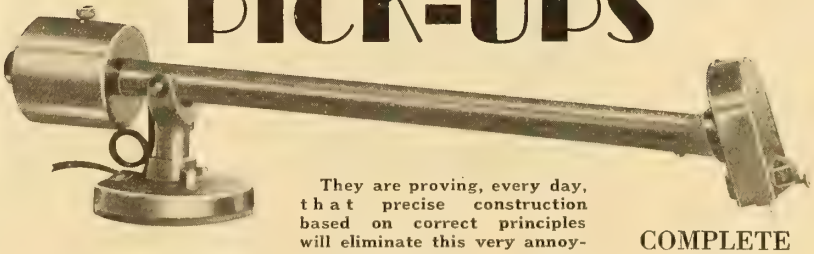
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Nothing to wear out

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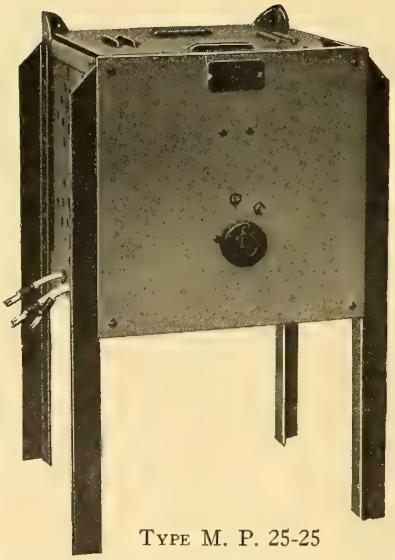
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No moving parts



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Advantages

Less Initial Cost

Saving of Current

High efficiency 80-86%

No special Booth required

Readily accessible

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Shockproof. No live parts exposed

Noiseless

No Oiling

Easy to Operate

Operate Two Projectors from One Rectifier
Your Supply House Can Tell You All About This Machine

FOREST ELECTRIC CORP., 272 New St., Newark, N. J.

Hatschek has described a non-intermittent projector of comparatively simple construction which utilizes a spiral concave mirror with an inner hollow face which rotates on a vertical axis once per picture.

The first paper of a series written on various non-intermittent projector systems has appeared recently. It describes the projector invented by G. Nilson in which one pair of oscillating mirrors are used to project the image in place of the usual large number of mirrors and prisms. Several patents have been taken out on optically compensated projectors which describe among others the use of a rotating disc (set at 45 degrees to the film plane), in the periphery of which mirrors are placed, the employment of a rotating polygon of refractors having plane parallel surfaces, and the use of mirrors carried by two rotors and arranged prismatically thereon, the number of mirrors being different on the two rotors.

Portable Apparatus

A sound-on-film portable projector has been marketed by Western Electric. A mechanical governor controls the continuous movement of the film past the photo-electric cell and sound lamp. Various devices have been patented for handling endless film bands in projectors, coin-in-slot operated projectors, and translucent screens. One patent describes a music roll on which are printed a series of pictures which show as motion pictures when the roll is rewound rapidly.

Screen Light Values

The porous nature of many materials used for "talker" screen construction has resulted in a serious lowering of screen reflection values and in a regrettable feature of sound pictures. One new sound screen uses staggered perforations and it is claimed that better picture definition is obtained accompanied by clear sound omission. The use of grid condensers mounted directly on a screen, referred to previously, makes available a sound motion picture screen which takes up little more space than a regular screen, overall thickness being about 16 inches. Parallel steel bands, 7 mm. wide and 0.1 mm. thick are placed in front of a screen to permit daylight projection. To avoid a direct black border on a screen, Keith-Albee hang a black velour curtain 10 feet behind the screen (which is exactly picture size) and use a black ground cloth on the floor. Patents issued include the use of an endless luminescent moving band viewed as a screen, several types of translucent screen materials, and the use of tiny glass pyramids embedded in a lead paint base.

Construction Data

The largest theater on the Pacific Coast was opened June 28, 1929. It

"Nerve Strain" Pay Asked by Sound Men

THAT sound projectionists have their troubles the world over is indicated by the following report of a wage scale dispute clipped from the Australian film trade paper *Everyones*: — Talkie projectionists here threatened to walk out en masse on Saturday if demands for increased wages were not acceded to. Now working on the award rates of £6/19/- (approx. $34.75) a week in the city and £6/6/- ($31.50) in the suburbs, they asked for an increase to £10/10/- ($52.50), and £9 ($45.00) respectively, and an additional £1 ($5.00) for city, and 10/- ($2.50) for suburban assistant projectionists.

At a meeting in the Trades Hall, of the Theatrical Employees' Association, Secretary A. E. Huckerby suggested that time should be allowed for further negotiations with employers' representatives before withdrawing from theatres.

"Nervous Strain" Angle

The following resolution was passed at the meeting: "That this mass meeting of sound projectionists resolves that owing to the higher responsibilities and increased duties entailed, and the alarming strain on the nervous system caused by sound pictures and in consequence of the failure of the employers to meet representatives of the union in conference, as promised, all sound projectionists be withdrawn from the conference unless increased wages and improved conditions are granted.

"That this meeting instructs the secretary of the Union to take whatever steps are necessary to give effect to the resolution demanding increased wages and improved working conditions." Representatives of employers forecast a wage increase.

---

seats 5,000 persons and is designed in French architecture. The projection throw is 212 feet. Sylvester has discussed the essentials in floodlighting for theater stages and points out that prismatic lenses in front of the projector are used to control beam spread instead of reflector contours. A marked reduction in reverberation and echo in public halls is claimed by Berliner to be obtained when the side walls are covered with wire cloth cement covered diaphragms. An audience filling one-quarter of the floor space is sufficient to prevent disturbances from the floor.

24-Inch Solar Lens

Motion pictures of the moon have been made at the Princeton University using a lens 24 inches in diameter. The picture shows the sunrise on the Copernic Cirque at a speed one hundred times faster than normal, the pictures having been taken at the rate of 10 frames per minute.

KEEP SEATS FILLED WITH THIS LENS

that banishes "audience eye-strain", one of the chief causes of attendance losses.

. . . . that, experts agree, gives better projection.

More and more alert theatre owners realize the vital importance of the projection lens in building "capacity" business. They recognize the fact that the public pays its money to be entertained . . . that it demands not only feature pictures but clear, realistic projection and complete freedom from eye-strain.

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A Splendid Labor Document

The accompanying text comprises the statement made by H. H. Broach who at the age of 37 years was called to succeed James Noonan as International President of the I. B. E. W., following the latter's tragic death in a Washington apartment house fire. President Broach's statement as published in the *Electrical Workers' Journal*, appeals to us as one of the finest labor documents we have ever read, and we feel that it cannot have too wide a distribution among trade unionists irrespective of craft labels. Having stated his position, President Broach concludes with the request that, should the Brotherhood disagree with his views or position, another man be elected to his place as soon as possible. This statement is a splendid labor document. — THE EDITOR.

EACH of my eminent predecessors had his ideals, his dreams. Each in his turn had to meet new conditions, new situations. Each had his own views and desires, his beliefs, his own way of doing things. Naturally I have mine. Some of these I wish briefly to enumerate here:

1. I desire no fair weather admirers or supporters, no false impressions as to what I am, what I believe in or stand for. I detest sham and pretense, hypocrisy and evasiveness. Frankness, plainness, saves one much annoyance and trouble.

2. I care nothing about titles and honors. These, I realize, are meant for the position, for the office, not for the individual. I do not want to be "popular." Popularity has too many dangers and pitfalls. People should be told frankly what they need to know, not what they like to hear.

Less Talk, More Work

3. I believe the day of emotionalism and bombast is done. We have had too much whining and crying and cheap oratory. There must be clearer, deeper understanding, less talk and more results, shorter meetings, and harder work. Speeches or "a few words" should be tolerated only when a definite, worth-while object is to be attained. "Chewing matches" have ruined many of our unions.

4. I believe in democracy only when it works. Confused ideas of democracy and free speech have wrecked more unions than any other thing. If democracy interferes with good business methods, then it is not likely good democracy. Phrases, words, slogans—all mean little today. Only results count.

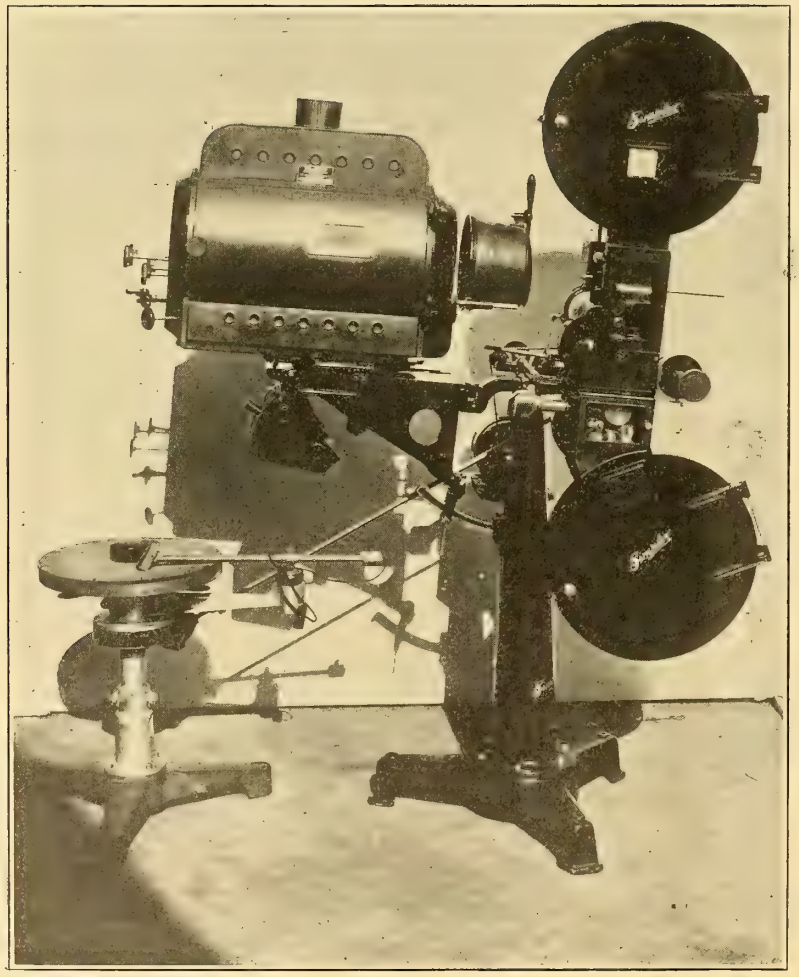
5. I hate bossism, cockiness or arrogance. But there must be strict discipline all along the line. No army ever got anywhere without order and discipline. Discipline and team-work never fail to get results.

Orating Theorist Gone

6. The sentimentalists, the cheer leader and lazy good fellow, the theorist and sputtering orator—all have about had their day. They taught us our lessons. Today we need plain speaking executives. We are already blessed with a number of these. We need to encourage and develop more men to manage our affairs—men of character, brains and courage—men who will not hem and haw over trifles or technicalities, men who will proceed to do the practical, commonsense thing.

7. I believe that the men representing this International and our local unions should conduct themselves as well as those representing any business corporation.

So far as those representing the International are concerned, two things will not be tolerated—drunkenness and laziness. I believe we have some good men, doing excellent work. Certain ones should be pensioned. Others should be given a chance to



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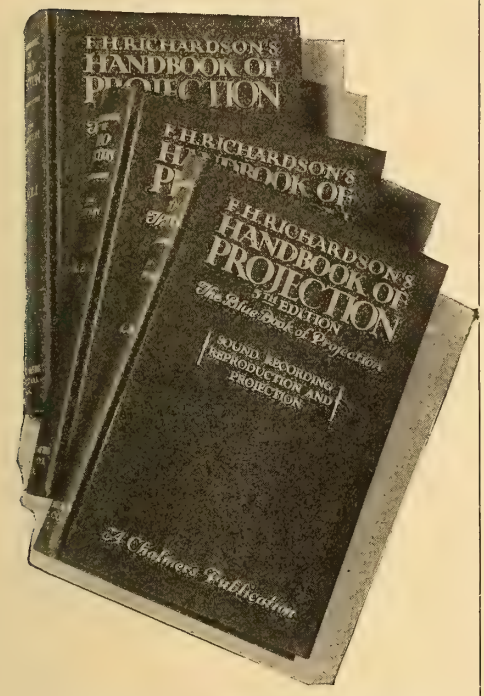
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do better. Others have had all the chances they deserve.

8. Labor politics sickens me. It has been a curse to many unions. True, one must use common sense and caution when dealing with groups or crowds. He must be tactful and sensible. But long ago I learned that *one can* do the right thing in union work. The only politics that should interest us, as Charles P. Ford puts it, is the politics of service. It's the best and most lasting.

9. Today I look upon the labor union as a business. It must be set up as a business, managed and run as a business. It's not the sociable organization it used to be. People cannot be rallied to "causes" as formerly. Revivals no longer "take."

I have no illusions about it. Nine out of ten people invest in the union today for what they hope to get out of it. The same attention should be given to this investment as is given to stocks and bonds. The benefits must be made so attractive, the investment so profitable, that no one can afford to get out of our union once he is in.

This is not as mercenary as it sounds. We are dealing with people, not with sticks and stones. The great traditional aims of labor unionism are still before us, but these must be accomplished, can be accomplished, in this generation, only by efficient business methods.

10. Too often unions have been mere fighting organizations. But an army never built a town, nor produced a harvest. Nine-tenths of a union's activity should go into constructive, peace-time efforts — into building.

Delegated Powers

11. No business ever got much of anywhere without a responsible head —neither can a labor union, local or International. We now face some of the same problems that business corporations have. We must meet them the same way. No successful corporation conducts its business by mass meetings. None ever think of it. Neither can a labor union that wants to be really successful.

12. I believe in reasonably high dues, high taxation, local and International. It produces more than speeches, complaining, wishing and hoping. No successful business can be run on a shoe string. It's like poor people hiring poor lawyers—and getting poor results.

Educational Needs

13. Every member should be an excellent mechanic. Excuses must not be tolerated. We must strive more diligently to see that everyone learns what he needs to know, what he is paid to know. Our card must stand for exactly what it is supposed to stand for—the best possible guarantee of good, clean workmanship.

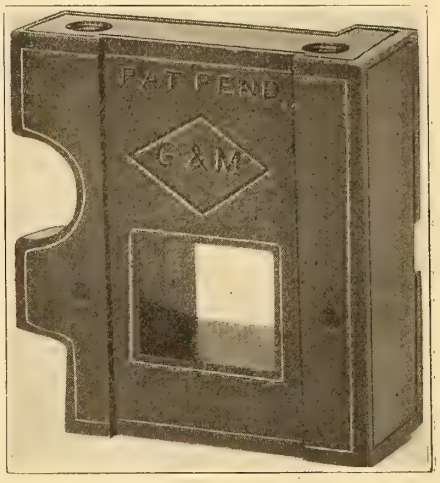
Much is now being done to school and train our members. Thousands are now required to attend night school. This work must be hastened. I believe in compulsory schooling of certain journeymen as well as apprentices and helpers, as is now the case in New York.

14. Our industry must come first. It's as much ours as the employers'. Its up and downs, its good and bad practices, affect us more than anyone else. We must develop complete and accurate facts about every phase of it. There must be better business, more business, and business on a more profitable basis.

15. I believe in honest, thorough and complete co-operation—not mere gestures—with our employers in every proper and legal way in ridding all branches of our industry of ignorant, uneconomic and destructive practices.

16. I know from long experience that our members are just as much

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responsible, if not more so, than their employers for the unsatisfactory and non-union conditions existing in certain places today. Some of our people have been so unreliable, they have committed so many childish blunders, have been so arrogant and narrow, that I have not blamed some employers for declining to do business with them.

Square Dealing Essential

17. My associates and I abhor wrangling, sputtering over trifles, and sparring and maneuvering for petty advantage in dealings with employers. There must be no hair-splitting or quibbling. We must insist upon substituting honest co-operation and understanding for bargaining, trimming and quarreling.

18. We must urge and encourage our employers at every chance to put their part of the business on a higher plane, to clean their house of burdensome, ungentlemanly and unbusinesslike practices and to have as their representatives competent, open-minded, modern business men.

19. I believe agreements must be held sacred, faith must be kept at all costs. Men once giving their word must keep it. Excuses cannot be accepted.

Conclusion

I want to work with others but do not propose to waste any time trying to tell the labor movement how to "save" itself. My first job is to try to attend to the needs of this organization.

I shall not be upset by hostility, criticism, or unkindness. I am pretty well hardened to all this. I have no illusions about men or life. I shall simply try to do the best I can, the best I know how, consistent with trying to preserve my strength and health.

And, if the Brotherhood does not favor the views and position outlined here, then I am certainly anxious that another president be chosen as soon as possible.

Local Union 650 Election

At a meeting on January 14th Local 650 of Westchester County, N. Y., held its annual election of officers. The members of 650 feel that some kind of record was set by them in returning to office for 2 years without opposition the same officers who have served the Local since the granting of its charter. These officers are: President James J. Shaughnessy, 1st Vice-President Irving A. Weiss, 2nd Vice-President Richard Hayes, Financial Secretary Fred Thome, Recording Secretary Ira Pye, Business Agent Arthur Martens, Chairman of the Board of Trustees Anthony Guido, and Trustee George B. Alley.

President Shaughnessy and his fellow 650 officers have an extensive educational plan mapped out for their members for the ensuing year.

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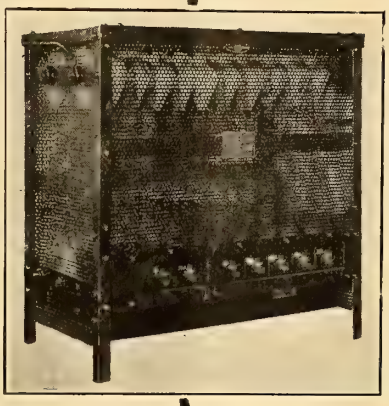
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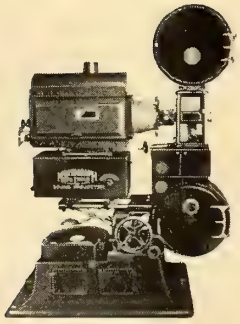
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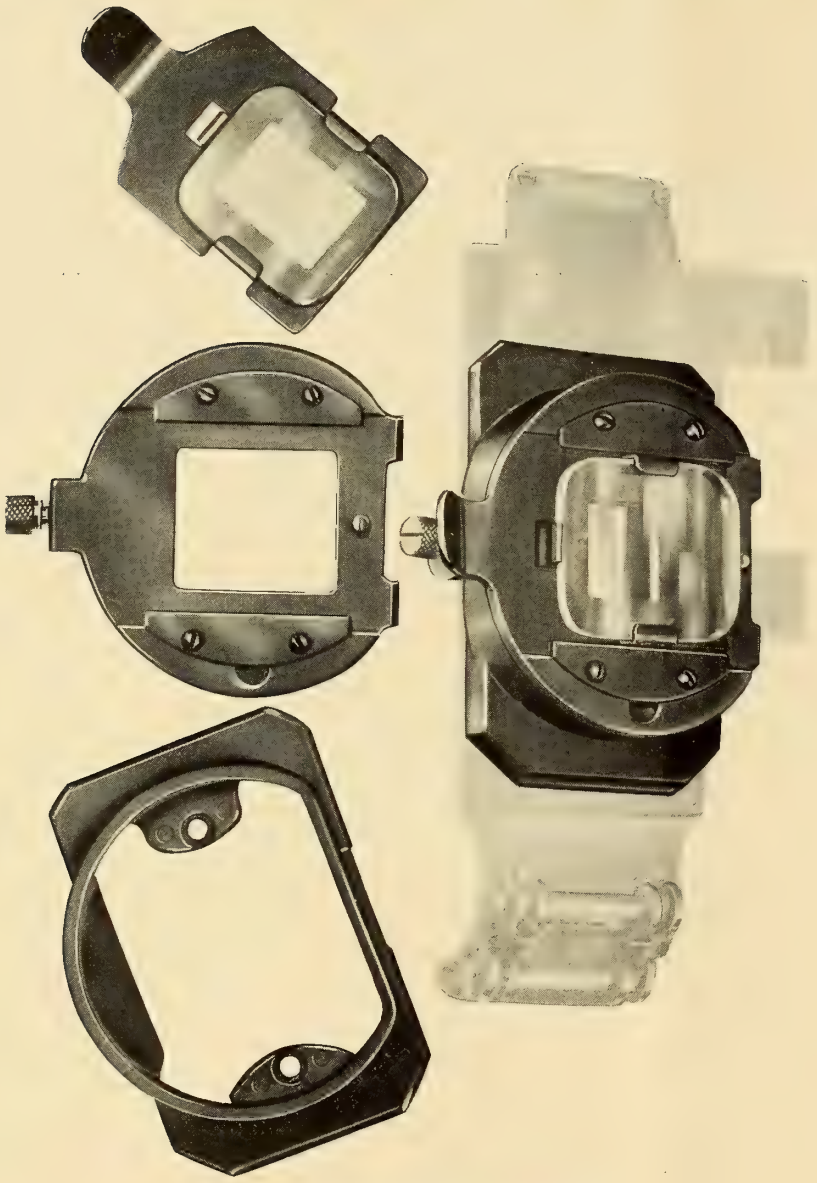
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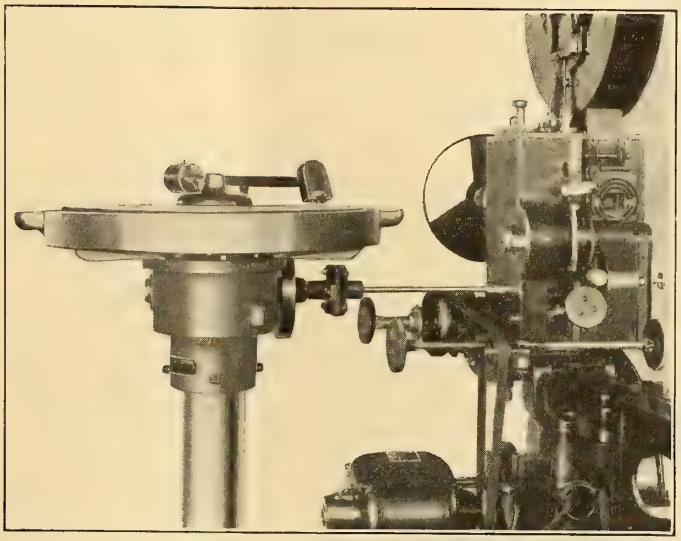
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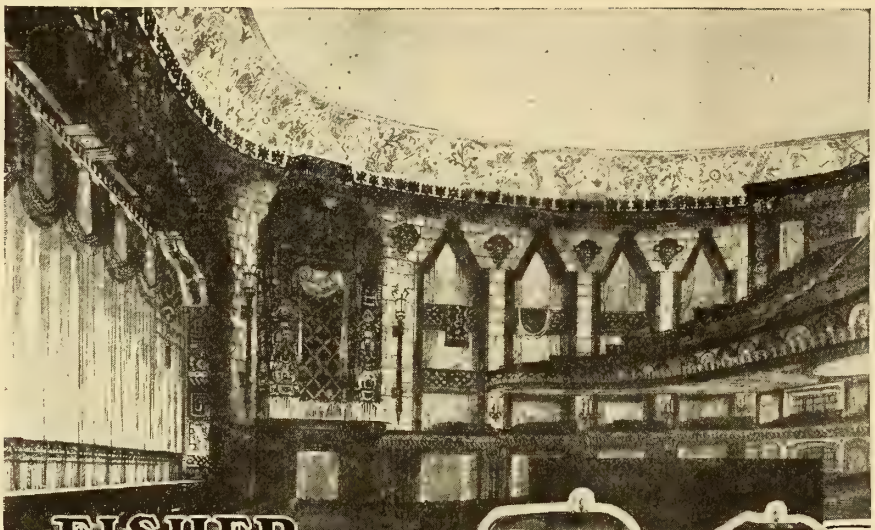
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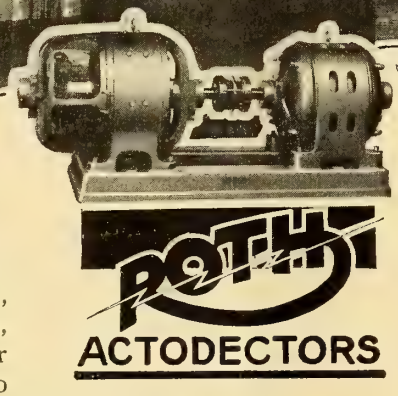
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Vol. 3, No. 5

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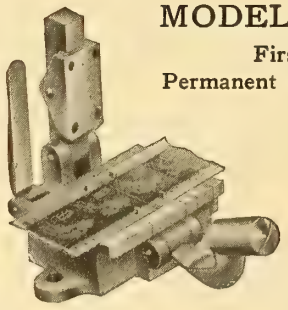
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S. M. P. E. Spring Meeting in Wash., D. C., May 5

The Society of Motion Picture Engineers will hold its Spring convention at the Wardman Park Hotel, Washington, D. C., May 5-8, according to the announcement of the Board of Governors.

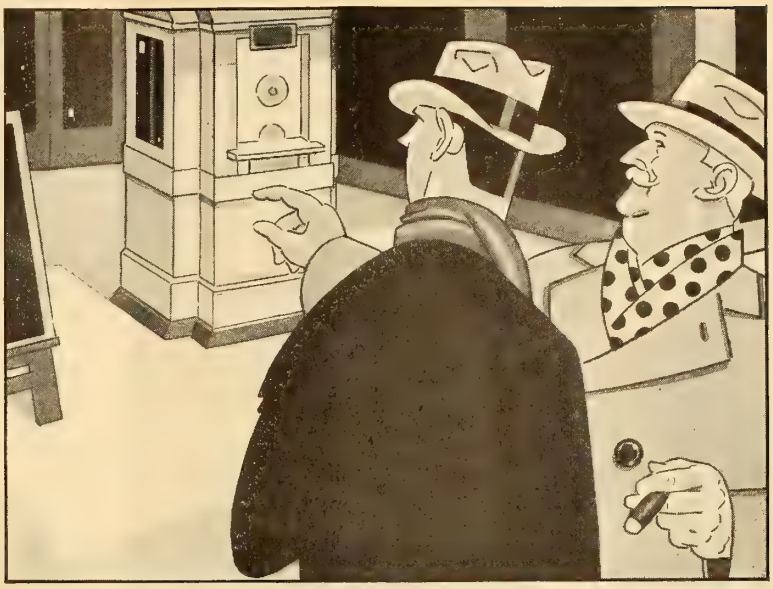
The various committees of the Society are already at work preparing a well-rounded program of papers and entertainment for the convention, and it is expected that this convention will be the most constructive and valuable yet held by the Society.

"While it is quite likely that details of sound picture production will receive a large share of treatment," reports J. W. Coffman, chairman of Papers Committee, "the Society recognizes the fact that the industry is now well stabilized in sound picture production and that the sound picture is the standard picture today.

"Horst" Three - Color Process

A British trade paper describes an exclusive demonstration of the "Horst" three-color process, which is to be used for the filming of sequences in conjunction with British Instructional Films, Limited. The color film shown reached a very fine standard of quality, with a complete absence of fringing. Three primary colors are used, and the color tones produced are very natural. A slight softening of the focus is observable, but this can be attributed to the special projector lens used at the demonstration: this was a simple type that had not been fully corrected for aberration. A properly corrected lens will shortly arrive in Great Britain, when a demonstration will probably be given to the trade.

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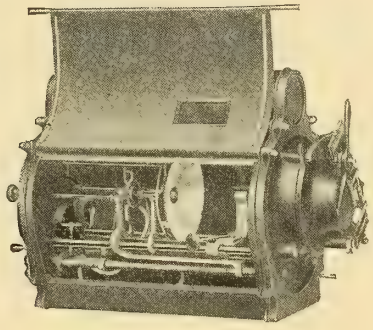
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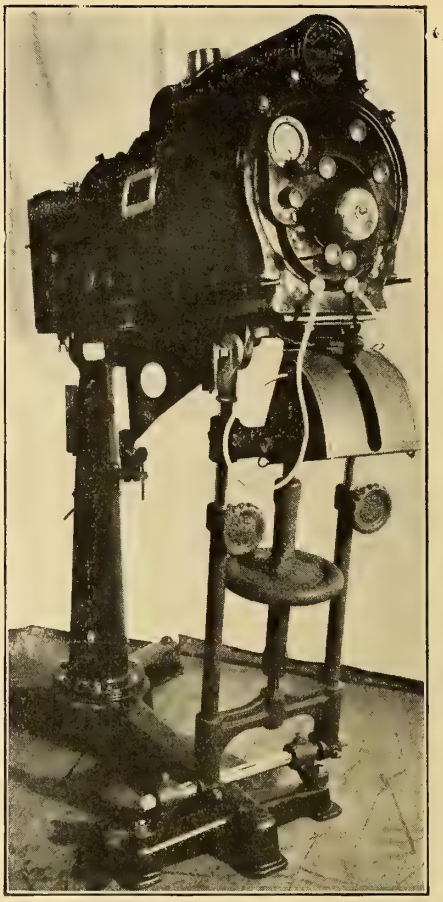
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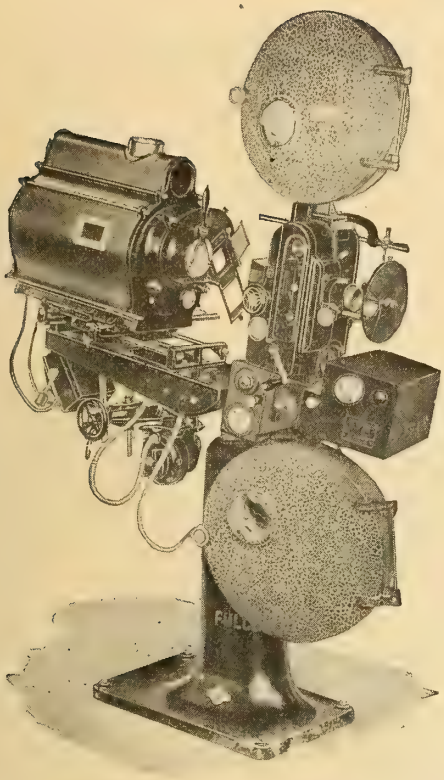
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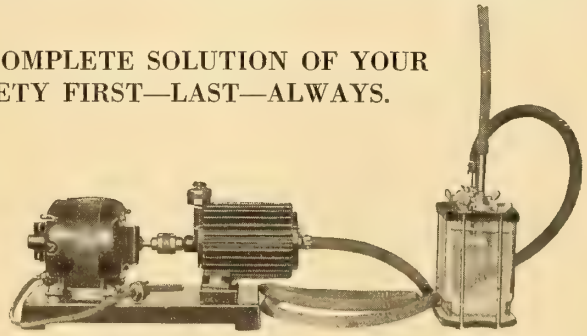
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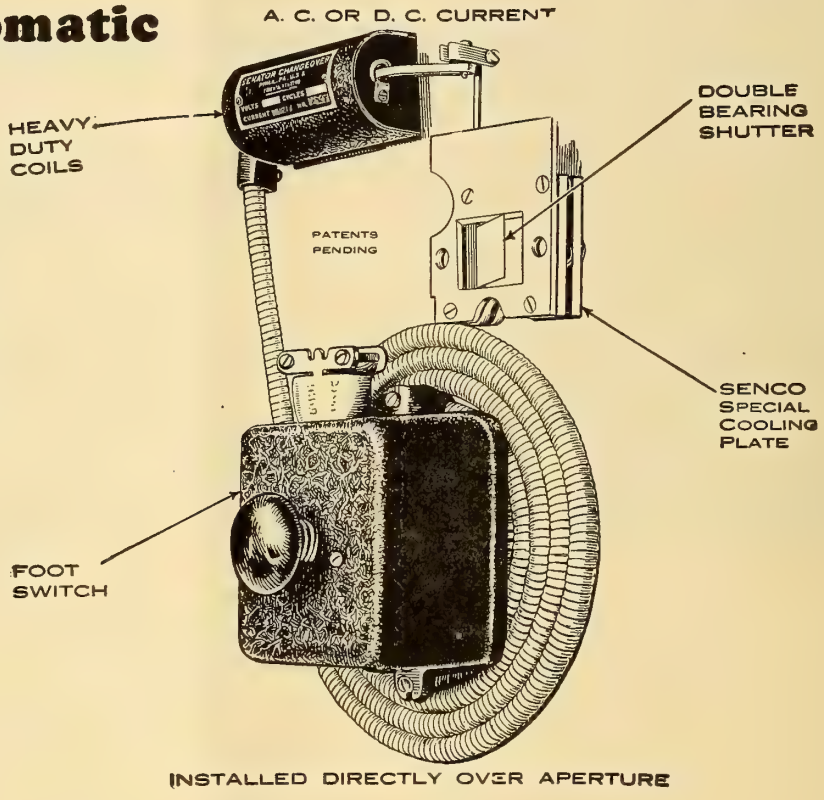
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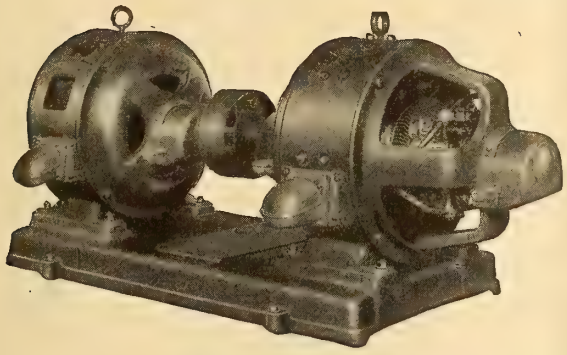
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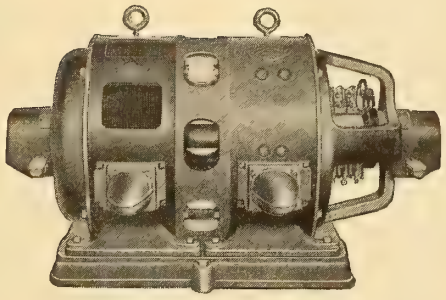
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Equipment Troubles and Maintenance

By C. R. TRAVIS

FIGURE 1 shows a resistance type of coupling between two vacuum tubes. This type of coupling lends itself ideally to producing a comparatively distortionless amplifier, but the gain or amplification per stage is considerably less than that obtained with a transformer coupling. The result is that a designing engineer will generally place a resistance coupling in the first stages of an amplifier which will then be followed by a sufficient number of transformer stages to bring the output up to the desired level.

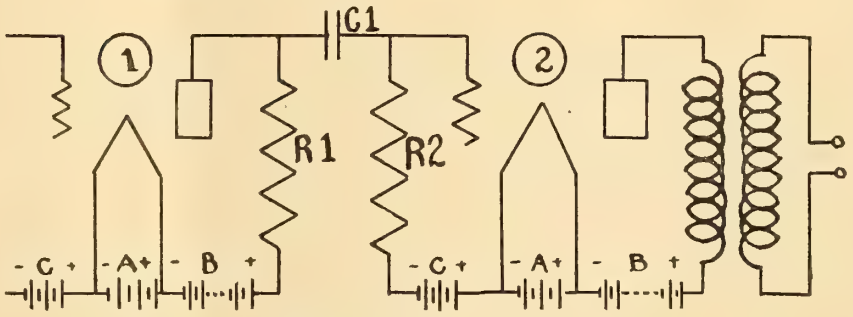


Fig. 1—Resistance coupling

In this case R1 acts as a means of connecting the "B" battery to the plate of the preceding tube and at the same time (due to its high resistance), acts to prevent the voice frequency voltage from returning to the "B" battery. The value of R1 varies with different types of tubes—in actual figures between one hundred thousand and two or three million ohms. The alternating voltage is impressed upon the condenser C1 which in turn allows the alternating current voltage to be impressed upon the grid of tube No. 2. The condenser also cuts-off the direct current of the "B" supply and thus prevents the voltage of the "B" supply from acting upon the grid of the following tube. The second resistance R2 is inserted in the circuit merely to complete the grid-to-filament circuit and to allow for the insertion of a "C" battery when required.

Thus, any change in the current flowing in the plate circuit of tube No. 1 will cause a rise or drop in the potential drop across the resistance R1, and this will in turn be impressed on the condenser C1 and from there to the grid of the second tube.

Impedance Coupling

Figure 2 represents a simple impedence coupling in which the resistance R1 has been supplanted by a choke coil or inductance, L1. This type of amplification is useful in some cases where it is desired to overcome certain forms of distortion or to introduce distortion, but it does not lend itself readily to distortionless amplification. The action of the coupling is very similar to that of a resistance coupling except that it is possible to design chokes so that the direct current resistance will be relatively low while the alternating current resistance or impedance will be relatively high.

Thus, the direct current as supplied by the "B" battery encounters very little difficulty in reaching the plate of the first tube; but the potential change as created by this tube encounters a very high resistance path in trying to return to the "B" battery. The result is that it is impressed upon the condenser C1 and from there is impressed upon the grid of the second tube.

Push-Pull Amplifier

Figure 3 shows a push-pull amplifier. In this type of coupling it is possible to make one stage handle a greater power than that of a single tube of the same type, but the gain per stage remains the same. As a result of the grids being at opposite ends of the secondary of the input transformer they will be opposite in phase, or, for a given impressed voltage upon the secondary of the transformer, one grid will be positive and the other negative by one-half the total voltage as measured across the extreme ends of the secondary. This may be seen in the diagram by observing that the return circuit for the grids of both tubes is taken from the center of the secondary. Likewise, at the primary of the output transformer there will be a duplication of this process.

When one tube has an increase in current in the plate circuit due to the grid potential going more positive, the other tube will be having a decrease in current in its plate circuit due to its grid going negative. Thus the current flow in the two sections of the primary winding of the output transformer will in effect be traveling in the same direction and the two halves of the primary will be inducing voltage into the secondary in the same direction at the same time. This type coupling is rarely used except in the last stages of an amplifier. For correct operation the tubes must be balanced within specified limits with respect to plate current.

Figure 4 represents a so-called cascade amplifier. This is merely a push-pull amplifier having two or more tubes in parallel on a side. Its purpose is to obtain greater power than could be supplied without using a larger type tube. The gain per stage remains the same as for that of a single tube.

Last month's installment, together with this short summary, should give considerable insight into the theory of amplifiers. Any points stressed in this series of articles which are not entirely clear to anyone will be clarified in these columns upon request. I have endeavored to keep the explanations of the functions of the various portions of the amplifier in as simplified a form as possible and to merely supply the foundation for an understanding of what happens beneath the can covers rather than to supply highly theoretical information. A good understanding of all the matters set forth in this series of articles should enable one to himself handle ninety per cent. of the troubles encountered in sound projection work.

Future installments of this series will be concerned with the analysis of every make of amplifier for which we

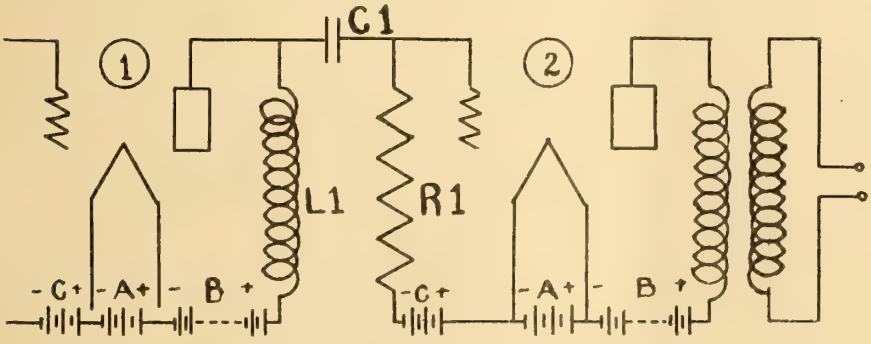


Fig. 2—Impedance coupling

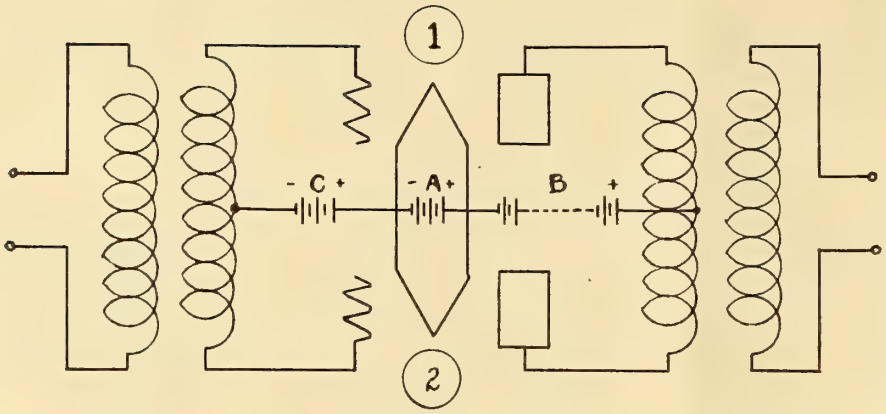


Fig. 3.—Push-pull coupling

can secure drawings. Meanwhile let us summarize briefly the highlight of the series of articles which is now coming to an end.

Systematic Trouble "Shooting"

Too much stress cannot be laid on the necessity for an orderly and systematic method of locating trouble in a sound picture apparatus. Obviously, to once more cite an analogy, one would not remove the radiator of an automobile if gasoline were not reaching the carburetor, and one would probably begin the search for such a trouble at the tank and then proceed along the gasoline lines, vacuum tank, strainers, etc.

Likewise with an amplifier. If the filaments of a vacuum tube do not light when the switches are turned correctly, it is obviously a waste of time to test the "B" batteries and the many other items that haphazardly come to mind. The filament circuit is an independent circuit and is only a small portion of the amplifier. It is dependent for its supply upon an outside source; and its failure to operate will cause an entire amplifier to be inoperative.

To pursue the analogy: if one finds that there is no gasoline reaching the carburetor, one does not take it all apart and ruin its adjustment. Therefore, why condemn six or eight vacuum tubes until it is definitely established whether the filament supply is reaching them? It is here so much better to begin a test at the "A" battery. If a system has a charging and distributing panel, test at the panel first and make sure that the "A" battery supply is leaving "okay" at the amplifier side or at the set of terminals electrically closest to the amplifier. Test at the connections to the amplifier and finally at the tube sockets themselves.

Tube Failure

When two or more tubes fail to function, the trouble will be found to be exterior to all of them, except in the case of a "short" in one of the sockets which is blowing a fuse that protects one or more tubes. Sockets are usually marked, but, if possible, disconnect the "B" battery supply before testing at the sockets. This will prevent possible personal burns and damage to the equipment.

Somewhere along the filament circuit the trouble will be found. It may be a dirty or corroded battery terminal or switch, a blown fuse, a loose connection at the back of the charging panel, or, in the case of a single tube in the amplifier itself, a dirty tube prong or contact spring in the socket. In all cases the location of the trouble will suggest its own remedy. There is no great difficulty in clearing an electrical trouble—that is, with equipment that has once worked satisfactory. The difficulty lies rather in *locating* the trouble. A drawing is essential to the proper location of trouble in all the larger sound picture systems, and it is suggested that drawings of various sections of the equipment, which will be published in these pages soon, be saved for future reference.

Types of Drawings

If modifications have been made to equipments for which you already have drawings, it is not unlikely that the attending engineer will be glad to make such corrections as are necessary to bring them up to date. There are two types of drawings. One is known as a theory drawing and is the type commonly used—except, of course, in extremely difficult cases of trouble. The theory drawing consists of only the parts laid out in a form most convenient for the draftsman and with the connections made at the most convenient place on the drawing. These drawings are correct in theory but they rarely show the connections as they are actually made in the panel.

A wiring diagram, on the other hand, does not lend itself readily to easy reading, but it does portray accurately every connection at the exact point at which it is made in the amplifier or panel. In addition, it usually states the wire colors and shows the cables and wire sizes to be connected and also gives the location of the equipment on the panel. This type of diagram is seldom used in trouble searching except where laced cable forms are used and the trouble is suspected to be in the forms or immediately associated equipment.

[*Note: This concludes the series of articles by Mr. Travis under the general heading of "Equipment Troubles and Maintenance," which occasioned widespread interest and proved very popular. Mr. Travis will contribute to an early issue—probably the next—the first of a series of articles on "Amplifier Fundamentals" in which he will trace step-by-step the majority of existing sound picture amplifier forms.*—The Editor.]

Respect for Craftsmanship

Mr. Addison Mizner, an architect, who has had much to do with the adaptation of the Spanish mode to Florida, in particular to Palm Beach, writes illuminatingly of his work in the January issue of *Arts and Decoration*. Mr. Mizner reveals the obstacles in the Florida environment to a complete and artistic adaptation of the Spanish type. He found it necessary to set up his own factory to make the materials, and he had to discover new materials for use. In the course of his article, Mr. Mizner declares:

> "Do you know that I am one of the few architects who holds a union card? I have several decorations but I am prouder of that one than of any other."

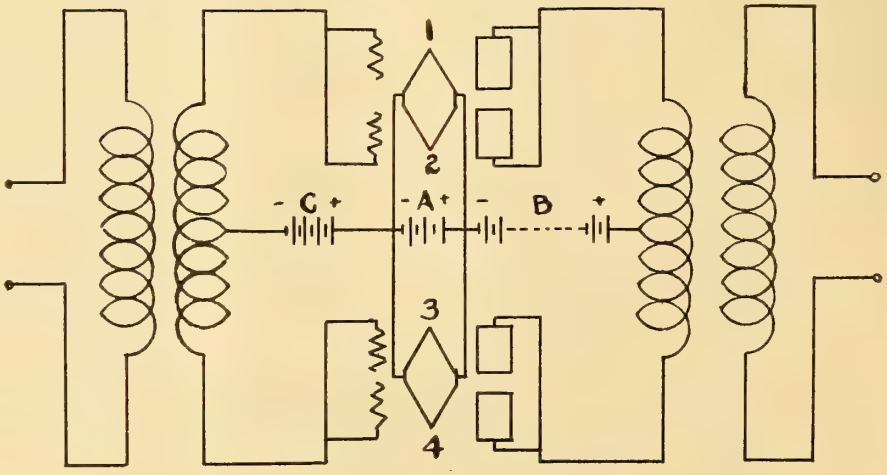


Fig. 4.—Cascading

Color Cinematography Processes

By PROF. RODOLFO NAMIAS*

II

THE light filters used for selection must respond to certain specific requirements. White light passing through the three filters is split up into three colored rays: upon recombining these three colors produce white light. The red light filter must entirely eliminate green, blue, and violet, and allow yellow and red rays to pass through completely; the corresponding negative is called the red negative. The violet light filter must completely eliminate yellow and green, and let blue and violet pass through; the corresponding negative being called the yellow negative.

Notwithstanding the great improvements achieved in the chromatic sensitization of plates and films, of which we have already spoken[1], there still are deficiencies which, though they are not very apparent in connection with negatives produced through red and violet filters, are all too apparent in those obtained under the green filter, namely, the red negatives.

Thus, while the print obtained through the green filter ought to give an excellent color for yellow, green-yellow, green-blue, and blue, in point of fact neither the special constitution of the pigments nor the chromatic sensitivity of the sensitive preparations now available allow a sufficient covering to correspond to all the colors from yellow to blue.

Serious Deficiencies

A spectral examination of the white light reveals the fact that yellow is almost entirely lacking, being limited to a very faint line; yet this same examination shows that yellow comprises a whole series of colors from orange-red to green. Consequently, when the impression of yellow pigment, so abundant in nature, is required, the green filter must necessarily allow a zone extending towards orange to pass through, while at the other end it stops at blue-green and completely excludes blue. Thus blue is not at all impressed on the plate or only very faintly so.

It follows that the red monochrome obtained from the negative produced through the medium of the green filter is always false, because the red invades the blue. In three-color photography and especially in mechanical three color photography, this serious deficiency in the red negative—that is to say the negative destined to supply monochrome red—is overcome by means of retouching. The operator so regulates the engraving of the plate used to print in red as to correct the invasion of the red to which we have referred.

Improvement Effected

To-day, however, an improvement has been introduced in three-color selection which, though of the simplest kind, is effective in overcoming the deficiency in blue covering. This consists in a very brief natural exposure of the negative after it has been exposed under the green-yellow filter.

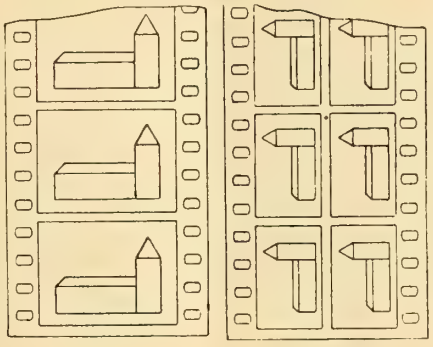


Fig. 1 Fig. 2

Fig. 1.—Shows conventional film with figure thereon, as is usual with ordinary black and white. Fig 2 shows the same image reduced and taken through color filters.

This very short exposure to white light produces a covering of the blue and violet, while it does not last long enough to produce any appreciable effect on the red, notwithstanding the panchromatic characteristic of the stratum. The author's own experience has shown that much better results are produced by this method whenever violet does not play an important part in the picture, violet being a much less important pigment in nature than blue.

This method eliminates the invasion of red in the blue, which turns the blue of the sky and of water to violet and falsifies the coloring of foliage, which being dark green in hue in the summer, acts on the sensitive stratum much more by the white light irradiated than through the green rays it emits.

In the case of paintings or costumes in which violet plays an important part, this supplementary exposure is apt to do more harm than good. In color cinematography in the open air, supplementary exposure would generally be very advantageous, but recourse cannot be had to it owing to the peculiarities of filming on a continuous ribbon. This gives rise to the idea of supplying the green filter with a little colorless aperture, through which a regulated quantity of white light can pass, just enough to impress the blue sufficiently.

What we have said above will suffice to show that three-color selection, though based on scientific principles, is an approximate process, in which the judgment of the operator plays no negligible part. Notwithstanding this, three-color cinematographic projection appeals to the eye, any deficiencies in color-rendering being overlooked owing to the rapid succession of the colored images.

Two-Color Selection

Two-color selection still is less precise than three-color selection; this system also relies on the complementary principle for the two light filters —that is to say, on the supply of rays of colored light which combine to produce white light. Pure yellows are lacking in two-color process, and blues and violets are not faithfully reproduced. The lack of yellow is made up for by the use of a yellowish light in the projection (incandescent electric light). It is always advisable in the case of staged scenes to bear in mind the limitations of the two-color process and to adapt the color of the scenery and costumes to its possibilities.

Thus, two-color cinematography, notwithstanding its serious deficiencies, may be very successful in delighting the eye, while it demands, as we shall see, much less complicated apparatus and handling than the three-color system.

Hitherto all the processes suggested or applied to color cinematography for public exhibition have been based on the principle of the selection of the natural subject in two or three monochrome images. The only exception is offered by the process based on the use of lenticular films recently applied by the Kodak Co. in amateur color cinematography, to which I referred in my previous article. It is, however, still extremely doubtful whether this process will be found practically applicable on a commercial scale, because it lacks a quality of prime industrial importance, that of the easy and perfect multiplication of copies.

Color selection is fraught with much greater difficulties for the cinematograph than for photography. The impression of the three images selected must, in fact, be impressed on the same firm by a rapid succession of exposures. The application of three-color selection, which is the process producing the most complete

*Rome, Italy.

[1] Subtractive Color Cinematography, Jan., 1930, Issue, p. 31.

and perfect image, here becomes a very difficult matter.

The execution of three monochrome images successively on the same film, automatically changing the light filter, is undoubtedly the simplest system, but we must not forget that successive exposures imply differences in design and coincidence. This is remedied in part by doubling at least the speed with which the film is changed, this speed being, however, limited by the exigencies of exposure through the medium of light filters.

The simultaneous filming of the three monochrome images eliminates the disadvantage in question, but as this simultaneous filming necessitates three objectives, we are again faced with the drawback of faulty coincidence, not because of the subject moving, as in the instance just referred to, but by reason of the phenomenon of parallax, whereby the perspective, and consequently the form of the image, changes according to the angle of view.

Three objectives placed one above the other focus the subject from different points, thus the flat images produced cannot be accurately superimposed. Optical means for overcoming this difficulty have been studied, and one of the most reasonable of these would appear to be the system devised by the Italian, General Russo, in which the three objectives are not arranged one above the other but are disposed in triangular formation with a single objective in front. In any case, it is clear that the simultaneous registration of three images through three objectives necessitates considerable alterations to both cameras and projectors.

Projection Considerations

To turn from the filming to the projection of the three monochrome positive images, it seems obvious that the successive projection of the monochromes must cause a serious strain on eyesight because the retina of the eye must take in, in rapid succession, the colors as well as the movement, and the redoubled or trebled speed with which the film is projected increases the jerky effect of the picture. The method of three objectives placed one above the other makes the same demand on the eye as the ordinary cinematograph, but if the standard dimensions were maintained the ribbon whould have to be shifted each time by 54 mm., which would be very inconvenient from the mechanical standpoint. We should add, however, that both those who use the one-objective system and those who use the three-objective system have found considerable advantage in reducing the size of the images, getting at least three into the format of two standard images.

Use of Colored Screens

In General Russo's apparatus, three tiny selected images take the place of a single normal cinematograph image; this avoids any increased strain either on the sight or the apparatus. The three-objective system can only be applied to the cinematograph by means of projection through colored screens.

On the other hand, by confining the selection to two colors, blue-green and red-orange, truly surprising results have been achieved; the same colors being utilized for the two monochromes whereby the image is recomposed. Thus, ever since its introduction, two-color cinematography by the process of subtractive synthesis on the same film has entirely replaced the two-color process of cumulative synthesis devised by Smith some twenty years ago, and more particularly applied in England. In the Smith process, the image was printed on the same film by the rapid alternation of the green and orange-hued filters. The same light filters used in selecting were made use of in projecting the positives, while doubling the velocity of the movement, so as to produce a correct sensation. But while this system, nowithstanding its unavoidable deficiencies, may have appealed to the eye by the color effects produced, it nevertheless caused considerable strain on the sight.

Hardly a cinema hall or theatre could be found willing to transform its projection apparatus so as to render the projection of the Smith color film process possible, and thus it died a natural death.

The author, who has had an opportunity to observe the Smith process, and who during recent years has watched two-color process films made by the American United Artists' Company, is in a position to affirm the enormous superiority of the latter.

Summary

Thus, after following the evolution of the processes of color cinematography and himself contributing his share by chemical researches, which constitute at the present time the bases of the methods used for producing synthesis (as we shall show later), the author feels justified in formulating the following conclusions.

In the present stage of knowledge, the color-cinematograph processes which present fewest difficulties and are most practical are the following:

1. Simultaneous selection and cumulative synthesis by the projection of black slides through the medium of colored screens similar to those used for selection. Difficulties of an optical and mechanical order have so far impeded the practical application of this process, the fact of special apparatus being required for their projection having also proved a grave obstacle to its being widely adopted.

2. Successive selection, limited to two colors, and subtractive synthesis by special chemical process, producing two monochromes on the same film one beside the other.

The Last Word on Reel Size

THE article "This Matter of Film Reel Size" which appeared in the February issue provoked a great many replies from interested readers throughout this country and in Canada. All of these comments, whether favoring one reel size or another, stressed angles of the matter which have been treated fully in these columns before, thus no useful purpose would be served by a repetition of same. Worthy of interest, however, is one detailed communication from John R. Marks, Secretary of Local Union 636, Lewistown, Pa., and his viewpoint is indorsed by six other members of this Local. This letter is appended hereto.

Copies of the article mentioned above were distributed to leading film producers, projection organizations, Local Unions and manufacturers, yet it is interesting to note that not one communication in support of the stand taken by producers in favor of single reels was received in response to a request for comment. This would seem to bear out conclusively the correctness of the statement made in the article that the matter was purely and simply one of producer convenience versus projectionist responsibility to put on a good show.

Nor was there received a single comment in support of its stand from any Local Union which has already arbitrarily decreed that members must not double-up sound film reels. Thus, it would seem that there can be no valid criticism of the statement that producer convenience is being served by the continued use of single reels, and that the weak and meaningless reasons cited by proponents of 1,000-foot reels were just that and no more.

Two Myths Dispelled

The discussion served one highly useful purpose, withal, and that was the laying of the ghosts of several bugaboos introduced by single-reel adherents which were calculated to deter any projectionist from doubling-up sound film. Chief among these "ghosts" were the matters of take-up tension and exciter lamp strain. The arguments on both these points have been very clearly defined, and it would seem that the double-reel men win easily.

The letter from Mr. Marks which follows covers very well indeed the major points made in previous discussion. Further space will not be given to this matter of reel sizes unless there appears someone who can conclusively demonstrate that he has a new angle on the situation which will

tend to clarify some of the points which have been discussed during the past few months. Thus, the following communication will serve to write finis to this subject pending the receipt of information which may have a new bearing thereon. Mr. Marks' letter follows:

I have read with a great deal of interest and no little amusement some of the "brilliant" comments regarding the use of 1,000-foot and 2,000-foot reels in recent issues of your magazine. The arguments advanced by those favoring single reels strike me as being the most peculiar I have ever heard. I have been a projectionist for a good many years and I feel that the following remarks anent this subject are based not on theory and hearsay but on actual practical experience as a motion picture projectionist.

Good Show Requisites

1. The thought that a projectionist would become lax in using 2,000-foot reels is indicative that such a projectionist has an inherent tendency towards laziness on any job. This type of man would probably make more errors while using 1,000-foot reels, because of the additional changeovers required and the fact that he probably would be *too tired* to watch the screen.

2. The thought that a show consisting of a feature on 2,000-foot reels and some acts on 1,000-foot reels might confuse the projectionist seems to me to be the most ridiculous argument of all. A projectionist who keeps constantly in mind the thought that his prime duty is the presentation of a good show and who will remember this while he is in the projection room, should never make an error of this kind. We have had sound in the theatre for fourteen months and our show consists of Vitaphone acts, disc cartoons, features on disc *and on 2,000-foot reels* and at no time has there been confusion.

3. The danger of fire is no greater with larger reels than with the others. I believe I am fair when I say that a very large percentage of film fires are caused by the carelessness of the projectionist. Proper inspection of film and proper adjustment to the projectors are essential. If these two matters are attended to, the danger of film fire is reduced to a negligible minimum.

Extra Time Factor

4. I notice several men complaining of the extra time that is required of them to double-up reels. It seems to me, a projectionist who is not willing to give approximately half-hour extra to his job by properly preparing his show would be better off in some other field of endeavor. In the second place, were 2,000-foot reels made standard, the exchanges would have them properly arranged on 2,000-foot reels and then there would not even be a requirement of spending an extra half-hour to prepare and breakdown the show.

5. Then, other men complain of standing at the machines for twenty minutes at a time. This again shows the thoughts expressed above, —that too many men apparently are anxious to draw their salaries but dislike to exert any effort for it. Authorities on projection agree that when you do remain at the machine for twenty minutes you are more certain to obtain the good results of projection—that is, focus, steady picture, good light, and good sound. In addition, it would give the projectionist more time to clean the movietone optical system, sound gate, sprockets, guide rollers, and other items that are important.

6. I believe if each one of us will watch our ammeter on the exciter lamp, we will find that the lamp will draw more amperage when it is first lighted; and I am quite certain that laboratories have proven through experiment the fact that the life of the lamp is greater when burned continuously that when the current is thrown into it and out, frequently. It certainly indicates that there is no strain on the exciter lamp when it burns for twenty minutes. In one particular case, we have burned out one exciter lamp in fourteen months.

Take-up Tension

7. I believe each one will agree that the argument on tension against 2,000-foot reels is quite ridiculous. From a close study, I have found that there is much more damage done to film by using 1,000-foot reels with two-inch hubs. We have found that a 2,000-foot reel with a five-inch hub renders the best and most even tension and results in better projection.

8. The use of 2,000-foot reels will absolutely cut in half the scratch marks, paint marks, and pasted paper that some of our "dear boys" use to assure themselves of the proper cues. I was under the impression that in this day of direct talking cues, we were through with this type of artist, but I find that they are still with us. As long as they are here, if we can cut their errors in half, that at least is a saving.

9. The edges of film are preserved for a much longer period of time when they are shipped on 2,000-foot reels in flat cases, rather than on 1,000-foot reels and placed one on top of the other in high boxes. When we first put in our equipment, all our movietone prints arrived on 2,000-foot reels and we at no time found the edges bent over.

Double Reel Advantages

As a final resume, may I say that the use of 2,000-foot reels will result in the following:

1. Will eliminate cue noises and motor starting noises.
2. Will result in more even tension.
3. Will allow better continuity in the show.
4. Will avoid damage to film in shipment.
5. Will make each man recognize the fact that a projectionist has a duty to perform in the proper presentation of shows.
6. Above all, will result in better sound projection, which is something we are all striving for.

I dislike very much expressing myself as I have in this letter, but I feel that most of the arguments that have been advanced, were done so because the men seem afraid to work just a little harder, and put forth a little more effort in their business. I am certain that our prestige will be improved when the members can prove that they are better projectionists and more interested in our work than non-union men.

I feel that each state should determine for themselves whether or not they desire the use of 1,000- or 2,000-foot reels. We in Pennsylvania (unfortunately), are not governed by censor laws of other states and we feel that we likewise should not be governed by their thoughts on projection.

I trust that this rather lengthy letter will iron out a great many misapprehensions on the part of the I. A. men and will at least stop so many of these ultra-foolish arguments. Yours for better projection and sound,

JOHN R. MARKS,
Secretary, Local 636,
Lewistown, Pa.

We the undersigned are heartily in accord and conformity with the above: (Signed) Charles M. Kessinger, Charles F. Klawitter, Walter Corbett, Clarence J. Trayer, Robert B. Webster, George Speece.

Fairy Tale

PITTSFIELD, Mass.—The Publix-Capitol Theatre here will be the second house in the country to be equipped for television, according to Manager Claude Frederick who has announced changes and improvements to cost at least $50,000. No interference with the operation of the house is contemplated and it is expected that the work will be completed by July. The name of the house is to be changed to "Paramount" in conformity with Publix leading houses in the United States. The only other house, so far as is known, to be equipped for television is the new Paramount in Springfield, Mass.

RCA "Type G" Reproducing Equipment

RCA Photophone "Type G" sound reproducing equipment was developed for the smaller theatre, the sound picture needs of which will be served as satisfactorily as are the larger theatres with larger type equipments. This RCA "Type G" equipment embodies many advances in the design of sound picture equipment, as will be recognized by projectionists who compare this type apparatus with earlier types. The following is the first technical information on "Type G" equipment to be published anywhere.

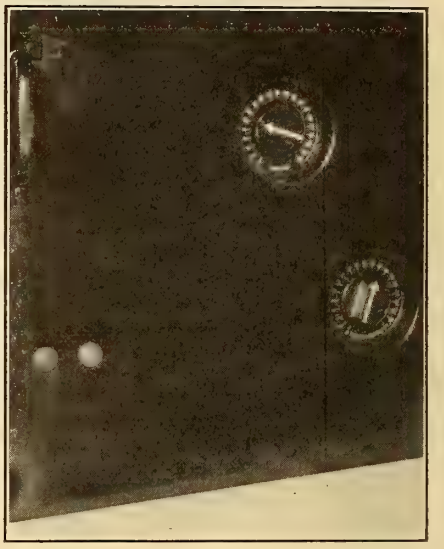
THE type "G" amplifier has been built as a very compact unit and the entire amplifier measures less than 25 inches square by 12 inches deep. This unit is designed for wall mounting and is placed in a sheet metal cabinet, presenting a very neat appearance. Inside the amplifier cabinet there are two units. One of these is the amplifier proper, which consists of three stages of auto-transformer coupled 112-A tubes, and a power output stage consisting of four UX-250 tubes connected in push-pull parallel. Both the voltage and power amplifiers are built into a single unit.

In the cabinet with the amplifier proper, there is a filter unit which is provided to eliminate all hum from the loudspeaker. The fading relay is mounted as a part of this filter unit and likewise a compensator is mounted as a part of this unit. The amplifier unit and the filter unit are each held into the cabinet by means of four bolts and either unit may be readily removed from the cabinet by removing these bolts. All connections from the outside are made direct to the filter unit and there is an interconnceting cable between the filter unit and the amplifier unit. There are no external connections to the amplifier unit. The amplifier unit and filter unit are readily accessible by removing the front cover of the amplifier cabinet.

The volume control unit is mounted in the amplifier and the dial for controlling volume extends through an opening in the amplifier cabinet cover. In the same manner the dial for the compensator extends through an opening in the cover. Both the volume control and the compensator are provided with name plates and graduated dials. Beside the volume control and compensator dials, the front of the amplifier cabinet contains two bull's-eyes which serve to indicate which projector is connected to the amplifier. In one end of the amplifier cabinet there is a jack for plugging-in a special input circuit, such as non-synchronous phonograph, etc.

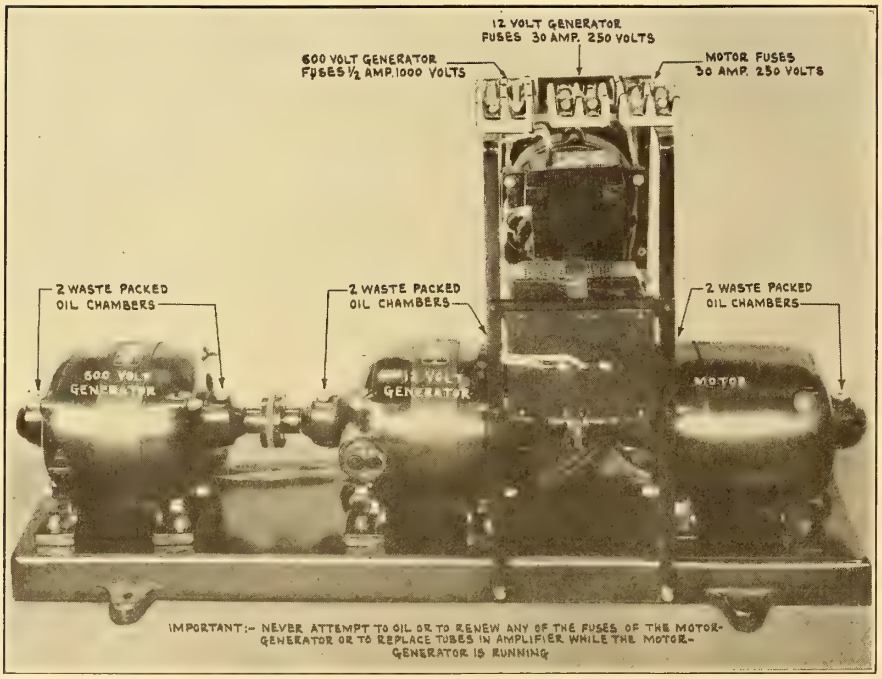
Motor-Generator Set

All power for the type "G" equipment is provided by a three-unit motor-generator set. *There are no batteries* except three small "C" batteries which are included in the amplifier. The motor-generator set has, besides the motor, a 12-volt generator and a 600-volt generator. The 12-volt generator furnishes current for the filaments of all tubes, exciter lamps, pilot lights and for the field of both the stage speaker and the monitor. The 600-volt generator furnishes plate current for all tubes and also furnishes polarizing voltage for the photo electric cell. Both generators are excited by the 600-volt machine. Standard equipment is provided with a 60-cycle, single-phase motor. A direct current motor may be supplied at additional cost.



RCA Type "G" amplifier cabinet, showing volume control, compensator, and pilot lights

The motor-generator set is provided with a control board which contains a rheostat for controlling the voltage of the 12-volt machine and a rheostat for controlling the voltage of the 600-volt machine. This panel also contains a 12-volt meter, a 600-volt meter and a motor switch. Behind the control panel and mounted as an integral part of the motor-generator set, is a fuse block containing fuses for the motor and for each generator. The motor-generator set stands on a felt pad which eliminates noise and vibration, and the entire assembly is covered by a perforated metal case.

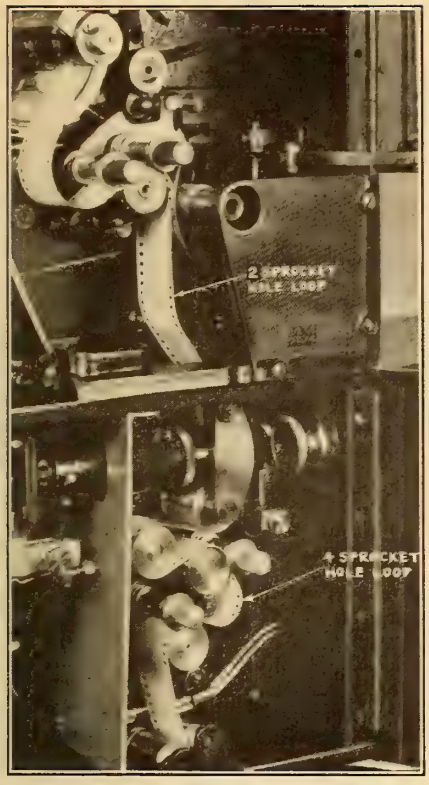


Detail illustration of RCA three-unit motor generator set used with Type "G" equipment

Sound Head

Type "G" equipment has been supplied with two types of sound heads, one for Power's 6B projectors and one for Simplex projectors, excluding types "M" and "R." Sound heads for operation on alternating current and the Power's sound head for direct current are provided with motors which are coupled directly to the sound head mechanism without chains or belts. Simplex sound heads for operation on direct current are provided with motors which are coupled to the sound head by means of a chain drive.

The type "G" sound head mechanism differs in many respects from that of the standard Photophone



RCA PG-13 soundhead on Simplex projector

sound head. A new type gate, known as the "impedance" gate, has been substituted and the viscous damping device has been removed. Film passes around a curved gate in the sound head and is held in place by two springs which are made in the shape of sled runners. After leaving the sound gate, the film passes around a roller which is on a shaft that carries a fly-wheel on its opposite end. The film passes around this roller and back to the constant speed sprocket. From the constant speed sprocket the film passes to the lower take-up sprocket and then to the lower take-up magazine. Inertia of the flywheel and roller serve to take out the "wows" or "ripples" and cause the film to be pulled through the gate at absolutely constant speed. The use of this impedance roller eliminates the viscous damping device.

Optical System

The optical system in the type "G" sound head has been somewhat simplified. The lens barrel is mounted rigidly in the sound head and is held in place by means of four bolts. The mechanical slit has been moved to the rear end of the optical system and rotational adjustment is made at that point. Focusing is accomplished by turning a knurled collar which varies the position of the objective lens. A ratchet device holds this knurled collar in position after the optical system has been focused. The entire optical system is fixed in position and cannot be moved sideways. The light beam is centered on the sound track by adjusting the film guide rollers at the top of the sound gate. The type "G" sound head utilizes the UX-868 photo cell, which operates at 90 volts potential. The sound head is provided with a condenser lens which focuses the light beam on to the photo cell.

The exciter lamp assembly differs from that of the standard Photophone sound head. Only one lamp is in position at one time. The lamp holder is removable and once a lamp has been set up and properly adjusted, it can be removed and replaced without affecting its adjustment. Each sound head is provided with an extra lamp holder so that an extra lamp may be set up and maintained ready for emergency use.

Fading is accomplished by means of a fading relay similar to that used with the type "F" equipment. A fading relay control switch is provided for each projector.

Synchronous Disc Attachment

The synchronous disc attachment is driven through a flexible shaft which is connected to the sound head drive mechanism through a bevel gear. The synchronous disc stands some two feet off the floor and is located alongside the projector. The disc mechanism differs considerably from that used in the standard Photophone disc attachment. First of all the entire mechanism runs in oil. The flexible shaft is directly connected to a worm gear, which in turn drives the turntable through a damping device.

In the bottom of the turntable pot, there is a leather disc placed horizontally and immersed in oil. A heavy iron disc which is coupled loosely to the turntable proper has its weight resting on this leather disc. The turntable and this weight are both driven from the worm gear through a spring mechanism. This damping device results in absolutely uniform and "wowless" rotation of the synchronous turntable.

Loudspeaker

Type "G" equipment is furnished with one loudspeaker. The speaker consists of an 8-inch dynamic cone driving element, having a 12-volt field and fitted with a 6-foot directional horn. This arrangement results in remarkable reproduction of all frequencies within the audio range and exhaustive tests prove this arrangement to be by far superior to anything else yet developed. The use of such speaker necessitates the purchase and installation of a sound screen by the theatre.

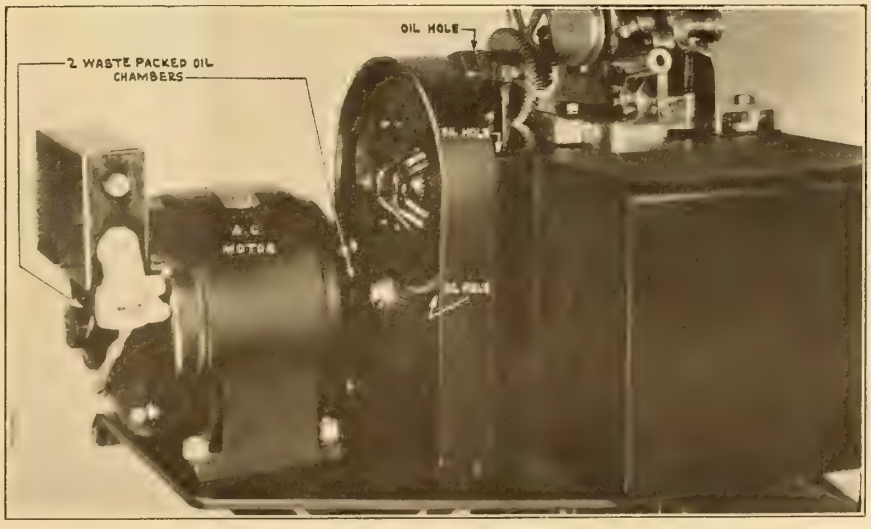
The monitor loudspeaker is of the 8-inch dynamic type, having a 12-volt field winding and a 24-inch square baffle. A volume control is mounted on this baffle directly below the speaker unit.

Operating Instructions

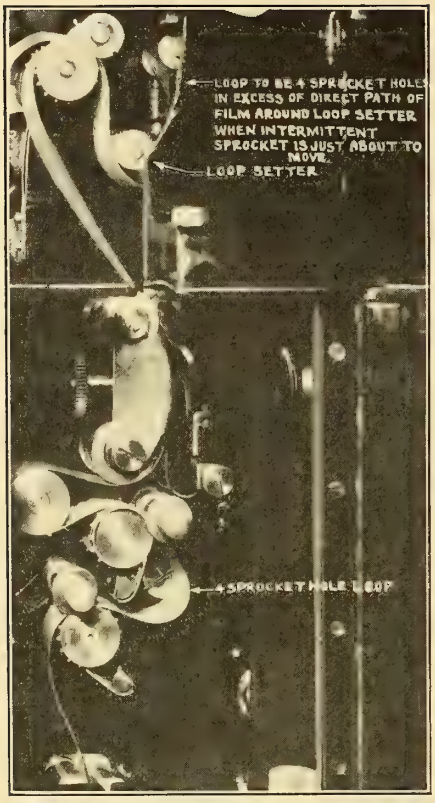
The operation of the type "G" equipment is simplicity itself. It is the duty and the responsibility of installation and service representatives to offer every possible assistance to the projectionist in order that he may know more about the equipment, and thus secure the perfect reproduction of which the equipment is possible. He should answer his questions and listen to his criticisms and forward his criticisms and suggestions to his supervisor, so that RCA Photophone Co. may have the benefit of his thoughts.

The entire equipment is placed in operation by turning the motor-generator starting switch to the "ON" position. As soon as the motor-generator set is up to speed, the voltages should be adjusted by means of the rheostats which are located on the motor-generator control panel. Each meter has a red mark indicating the correct reading. It may be found that it is desirable to have the volume control set at zero when starting the motor-generator set. If the volume control is set above zero it may be found that there is a "rushing" noise in the loudspeaker when the generator set comes up to speed. Any noise in the loudspeaker may be prevented by having the volume control set at zero.

The type "G" sound head is thread-



Drive side of Powers A.C. soundhead for Type "G"



Type "G" soundhead on Powers projector

ed as follows: After leaving the lower take-up sprocket on the projector head, the film passes over the sound gate in the sound head. The film passes over the guide roller at the bottom of the gate in a clockwise direction, and from this roller runs to the impedance roller and over it in a counter clockwise direction. From the impedance roller the film passes to the constant speed sprocket and passes over this sprocket in a clockwise direction. A short loop is left immediately following the constant speed sprocket and the film then passes over the lower take-up sprocket in a counter clockwise direction.

From this sprocket the film passes directly to the lower magazine. A slack of four sprocket holes should be left between the projector head and the sound head. Likewise, a four-sprocket hole loop should be left between the constant speed sprocket and the lower take-up sprocket in the sound head. It should be noted that the film is to pass around the loop setter on the Power's projector, but the loop setter is to be locked in position by the spacer which is provided with the sound head.

Exciter lamps supplied with type "G" equipment may be operated at any current up to 7½ amperes. A spare lamp should always be kept set up in the spare exciter lamp holder.

The film disc switch should be set for the desired reproduction and the fader switch should be thrown to the machine which *is not* to be started up. As soon as the machine is up to speed the fader switch should be thrown.

If the picture has not been cued previously, it will be well to start with no compensation. This means that the *compensator dial* will be turned as far as possible in a clockwise direction and will point to the figure 40 on the dial. This compensator has been provided to compensate for lack of intelligibility on poor recording. If the recording consists of music only it will be found most desirable to run with the compensator set at 40. If, on the other hand, the recording contains speech, it may be found necessary to lower the compensator setting. If the speech sounds "boomy" and is not intelligible, the compensator should be reduced gradually until the speech is cleared up. *Never run the compensator lower than is absolutely necessary* for intelligible reproduction. If the compensator is run at too low a setting, the quality will be greatly impaired and the sound will be "tinny" because of a lack of low frequencies.

Volume Control

Volume is controlled entirely by the volume control which is located on the amplifier. The volume of sound from the loudspeaker should always be kept just as low as is consistent with intelligible reproduction. Acoustic analysis and recommendations for the treatment of the theatre are made on the basis that the intensity of sound will be kept at its lowest possible value. The installation representative should impress upon the Exhibitor and the projectionists the necessity for keeping the volume as low as possible and should explain to them that reverberation in excess of that calculated in acoustic recommendations will result from excess volume.

The installation representative should point out the desirability of having a signal system between the orchestra floor and the projection room. Due to the extremely low cost at which RCA Photophone leases the type "G" equipment, no signal system has been provided. There should be little difficulty in convincing the exhibitor that a signal system will result in improved programs because of closer cooperation from the projectionist. It should be possible to use a simple buzzer system for this purpose, using one buzz to raise the volume, two buzzes to lower the volume and three buzzes to indicate trouble.

Suggestions and criticisms from projectionists have proved of very great benefit in the past. RCA Photophone takes this opportunity to invite a continuation of constructive criticism from projectionists who work their equipments.

Sound Should Be 'Easy to Listen To'

By S. K. WOLF

Theatre Acoustics Engineer, Electrical Research Products, Inc.

THERE is a great deal more to this matter of sound than simply making a program understood. Public psychology demands that it be "easy to listen to." We can discuss this subject in terms readily understood by everyone, namely percentages. A theatre can be rated in the percentage of intelligibility of speech, which is the index of "how easy to listen to" the patrons find sound in that theatre. Telephone engineers have found that a good measure of the efficiency of a transmission system is in the percentage of disconnected, meaningless syllables that can be understood through it. This is called an articulation test.

An articulation test of normal speech direct from speaker to listener under perfect conditions gives 96 per cent. If there is any doubt in your mind that speech cannot be transmitted 100 per cent under ideal conditions, try this simple test. Ask your listener to close his eyes so that he may not read your lips.

Articulation Tests

Then you say the following words once each—*map, nat, mack, nap, mat* and *nack*, and ask him to write them down as you say them. Providing you do not unduly emphasize the final consonant of these words, you will find that one or more of them have not been understood. This gives you an idea of the difficulties encountered in speech transmission.

The loudness with which sound equipment is operated is an appreciable factor in the intelligibility of the resulting sound. There is a fairly broad range of volume about equivalent to the volume used in average conversation, for which there is no depreciation in intelligibility. However, as tests have shown, if the loudness is somewhat greater or somewhat less than the conversational loudness, we can expect a reduction of articulation of one to five per cent.

Another factor influencing the intelligibility of speech is the amount of extraneous noise present. Audience noise is of two kinds. The first includes whispering, coughing, laughing, rattling of programs, etc., and is not controllable by the exhibitor. The other, scuffling of feet on concrete floors, is controllable and eliminated with the use of carpet. Further noise is often introduced into a theatre by and through the heating and ventilating systems, and street noises sometimes enter through this channel. This, too, is controllable. Tests have shown that if the aggregate noise is 20 per cent as loud as

Volume (Cubic Feet)	Reverberation Period (Time for sound to diminish to .000001, its original value at 512 cycles)	% Words Understood by Audience	% Vowels Understood by Audience	% Consonants Understood by Audience
270,000	2.8 seconds	84.8	99.6	91.7
280,000	3.0 "	82.2	99.8	88.5
310,000	5.0 "	64.5	97.0	79.0
In two other halls where the walls absorbed much less sound the results were as follows:				
280,000	5.3 seconds	56.3	92.0	73.0
320,000	7.5 "	44.0	88.0	65.4

Reverberation chart, after Sabine, showing intelligibility factors

the sound, the articulation will be reduced 10 per cent.

Excessive Reverberation

Excessive reverberation is still another factor tending toward decreasing the articulation in the theatre. If, in any given theatre, the reverberation exceeds by two seconds a certain optimum value, a reduction of 10 per cent in the articulation results. It can be readily seen that this condition is often encountered in houses not properly treated acoustically when the audience present is small.

There are two more factors to be considered before we can round out our estimate of the probable articulation of the theatre and these are the percentage reduction necessary on account of the recording and on account of the reproducing system. Since the articulation rating for speech under the best conditions from the original sound source is only 96 per cent, let us assume that the best possible recording and reproducing would be 95 per cent each or a reduction factor of 5 per cent each.

To sum up these reduction factors and to get an idea of how a theatre would rate under the conditions that I have outlined above, we get the following:

Percentage articulation of original speech under perfect conditions	96
*Percentage reduction due to incorrect loudness	5
*Percentage reduction due to extraneous noise in theatre	10
*Percentage reduction due to reverberation	10
Percentage reduction due to recording	5
Percentage reduction due to reproducing	5

* Controllable.

Applying the above listed reductions to the original 96 per cent in the regular commercial method of applying discounts, we find the resultant percentage articulation to be 67 per cent.

Listening Strain

Extensive tests by Dr. Fletcher of the Bell Laboratories have enabled him to draw a curve showing the relation between the percentage articulation of meaningless syllables and the resultant conversational efficiency in which the listener has the aid of context of the sentences in which the syllables are found. From this curve we find that in a theatre having an articulation rating of 67 per cent, the conversational efficiency would be 90 per cent. This means that the patrons would miss about 10 per cent of what was going on, which could keep them under a continuous strain to try to make it out. This strain is perhaps not conscious but does interfere with the ease and comfort of the audience.

Loudness of operation, extraneous noise and reverberation in the theatre are controllable in ways described above.

In addition to these measurable factors there is another that has an appreciable place in show psychology, illusion. The sound must appear to come from the picture and yet the listener must be allowed to feel that he is in the same room with the speaker. With present day recording the areas around and immediately in back of the horns should be sound reflecting, which allows the "room tone" of the recording to become associated with the "room tone" in front of the theatre so that the listener unconsciously feels that he is in the same room with the speaker.

With so many factors bearing upon the net result, each presenting its reduction factor however small, it behooves the exhibitor who wishes to preserve and increase his success, to see that all reduction factors within his control are kept to the absolute minimum.

The best possible equipment obtainable, properly operated in a theatre that is acoustically correct and free from extraneous noise, is the only possible answer to "easy listening" and increasing receipts.

An Old Question—and the Answer

By PAUL H. ALLEN, A.S.C.

I BELIEVE that the one question that I have answered more than any other since I have been in the motion picture business is, "Why do automobile wheels turn backward on the screen?" The reason why is simple, but the answer without a diagram isn't so easy. But I believe that by referring to the illustrations on this page it will be quite plain.

Of course you all know that "moving pictures" don't really move, but are just a series of individual snap shots showing the successive positions of moving objects. But it is just these successive positions which may easily produce the illusion of "wheels turning backward," which quite naturally are going in the right direction. This fact can be illustrated by the diagram (Figure 1) of four-spoked wheels rotating at such a speed that after one picture of the film has been exposed the spoke "A" has turned around just enough to show "A" at the position of "B" when the next picture is exposed. It is then quite evident that in a case of this kind, if the spoke and camera keep turning at constant speeds, when the picture is projected upon the screen it will appear to be standing perfectly still.

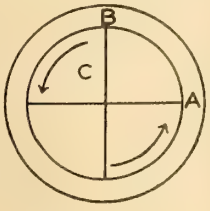


Fig. 1

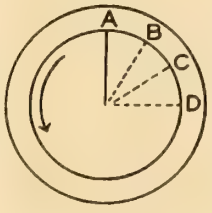


Fig. 2

Again, the wheels on fast-moving cars often appear as if they were moving backward. This would happen if the spoke "A" had been revolving so fast when it was photographed that the interval between one exposure and the next the wheel revolved all the way around from "A" to "B" (Figure 2). When the next successive exposure was made the spoke appeared at "C," and so on.

When this film is projected on the screen the spokes will seem to run backward. No matter how many spokes there are in the wheel, it is evident that the effect on each one will remain the same, and the entire wheel will appear to turn backward at the same speed as that of each spoke.

The so-called mystery is nothing more than an optical illusion. How can this be avoided?

Several ways. If one must show an automobile being driven across the screen in a film, try and select one with disc or wire wheels. Or shoot the car from the front or rear in such a position that the wheels do not show on the screen. Or let them turn as they may!

As The EDITOR *Sees* IT

¶ *Projectionists and/or Radio Men*

SUCH statements as "The radio and the movies join forces to introduce a new era in entertainment" and "Motion pictures lock hands with radio" are getting to be an old refrain in these days of rapid development of the sound picture. We who were active in the motion picture industry before sound pictures were introduced often wonder if the former has not been overpowered by the latter and swept off its feet to a point where the primary consideration in picture making, distributing and reproducing is sound. Sound, sound, sound—the air is filled with echoes of the word. Not that we oppose the progress of sound pictures; not at all. We like them. We think it improbable that more than a few workers in the industry opposed sound pictures, and those few may be found in the ranks of actors who have not a "sound voice" (whatever that may be); musicians, and stagehands. And we are not so sure that the musicians will not regain a goodly portion of their lost ground.

Specifically, what we have in mind is the fact that motion picture executives, hitherto impervious to all outside uninformed opinions on how best to run their businesses, have suddenly become softhearted and have opened their arms—and, literally, their checkbooks—to all manner of promoters—mostly "sound men," *radio men!* Radio men are perfectly all right in their own little sphere, but of late we have been forced to the conclusion that they know mighty little about motion pictures. Still, there are few who will deny that they are practically running the picture industry today—at least from the production and reproduction viewpoints—and high-handedly at that.

In no section of the industry is this tendency to give ordinary radio men, full sway than in the projection field, particularly in the posts of supervisors of projection. This condition is one that should be fought against. Men who don't know the first thing about motion pictures themselves are receiving appointment (usually after a conference with an executive who knows nothing and cares less about projection) to the posts of "Sound Supervisors." Following their appointment they proceed to take over the direction not only of sound but of motion pictures; and the results of their meddling are to be seen in hundreds of theatres today.

The position of supervisor of projection demands hard work, long experience in *motion picture work,* the ability to handle men, contact with the proper organizations and a certain intimacy with the officials of such organizations, creative ability—showmanship! Possessing all but the last qualification, a projection supervisor would be a failure. It simply isn't in the cards for anyone to come fresh from the radio industry into the motion picture business and possess all of the qualifications cited above. Most of the "sound supervisors" this writer has met are so unbelievably conceited on the point of their knowledge—presumably—of radio that they never even give a thought to motion picture projection.

The pity of this situation is that picture executives seem disposed to back-up an incompetent "sound supervisor" in all disagreements with a projection supervisor. The answer to this short-sighted policy may possibly be found soon in the general ledgers of various companies under the heading "Projection Department," and it is unlikely that many executives will display much enthusiasm for that answer.

Wide Film Arrives!

WIDE film, long promised but deterred on many occasions from making its premiere bow in a representative motion picture theatre, has at last arrived and is now filling the spacious Roxy Theatre in New York City to capacity at all performances. The show at the Roxy looks good, and if one went to that theatre simply to see the picture and without straining one's eyes for defects in the presentation, one would see a motion picture show projected as faultlessly as the best projected standard-size film. The Grandeur system has its little kinks which need ironing out, of course, but in all other respects it is a grand show. Its sponsors are to be congratulated for turning in a splendid piece of work.

In some respects, wide film is to us a more interesting development than is sound pictures. With the old silent film one always seemed to have a sub-conscious feeling that the characters on the screen should be heard as well as seen, and when they finally did make themselves heard we took the whole matter rather complacently. But to the uninitiated wide film offers a new delight: no human eye is prepared for the grand spectacle it presents. And when it arrives in color—it will be the *last word* in entertainment.

It is a matter of keen regret to us that information on this development is not yet available for publication, but we have high hopes of presenting same in an early issue—probably the next.

Projection Apertures for Sound-on-Film

By LESTER COWAN*

RECENTLY much concern was aroused among Hollywood studio technicians by the fact that in some theaters the heads and feet of characters, important words in titles, and other vital elements of the picture were being cut off in projection of sound-on-film pictures. Projectionists were inserting in the film gate a solid sliding aperture (Fig. 1), which masked out from the top and bottom of the picture an amount sufficient to restore the normal picture proportions. The smaller aperture reduced the height to three-fourths of the width which had been diminished by the addition of the sound track. The smaller rectangular picture when projected with a one-half inch shorter focal length lens filled the screen with a picture equal in area to the silent picture.

Except in a few cases, cinematographers had not been warned of the reduced aperture practice. They did not anticipate it in their photography. The result was that parts of the picture were being cut out which cameramen assumed would reach the screen as usual. Studio technicians in general were at a loss to know what to do; they did not know the extent of the practice or the exact size of the reduced aperture. An immediate coordination of studio practices with existing theater methods was imperative. To this end a nation-wide survey of theater chain and production studio practices was launched by the Academy of Motion Picture Arts and Sciences with the assistance of the Technical Bureau of the Association of Motion Picture Producers. Theater chains listed in the accompanying chart responded to the inquiries which were sent out.

Summary of Theater Practices

Replies from theaters reveal four different practices, alike in that each provides for matting out the sound track by a movable masking device, but different in their manner of compensating for the screen area left blank because of reduced picture width due to the addition of the sound track. For the sake of convenience let us refer to these four practices or methods as methods *A*. *B*. *C*, and *D*.

Method A—Combination of Reduced Aperture with Shorter Focal Length Lens.—An aperture is inserted in the film gate which masks out, in addition to the sound track, a portion from the top and bottom of the picture sufficient to reduce the height to about three-fourths of the reduced width. The smaller 3 by 4 picture is enlarged by a one-half inch shorter focal length lens to fill the screen. Re-centering is accomplished by auxiliary devices which enable the lens on the machine to be moved from right to left. Unless due allowance has been made in production for this smaller aperture vital portions of the picture will almost certainly be cut out. The estimated cost of installing this method is $200.

Method B—Movable Mask or Flipper.—A movable mask or flipper about 30 inches wide at the left side and facing the screen changes the screen shape to correspond with the picture shape. When sound-on-film pictures are being shown it is moved over to cover the blank strip on the left of the screen. The flipper is operated by a stage hand, some member of the regular house staff, or by remote control from the projection room.

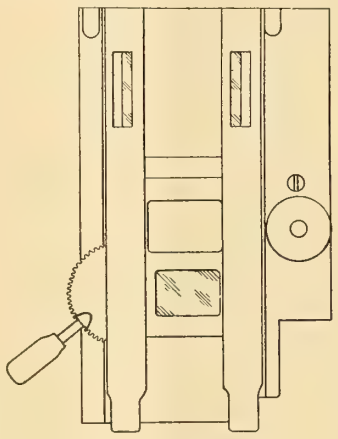


Fig. 1. One attachment used to simplify change from small oblong aperture to large aperture

Method C—Blank Strip on the Left Side of Picture.—A sliding plate masks out the sound track. A blank strip shows on one side of the screen.

Method D—Small Blank Strip on Each Side of the Picture.—Rather than leave a blank strip on the left side of the picture some theaters shift the projection machine in order to center the picture, so as to divide the blank area between the two sides.

Economic Consideration

As conditions are constantly changing it does not seem possible at this time to give an accurate estimate of the number of theaters employing each of the four methods referred to above. From information received it is reasonable to assume that theaters using methods *C* and *D* are almost exclusively the smaller houses with less critical audiences due to lower admission prices. These theaters proceed cautiously before adding new devices which increase their overhead or operating expenses. The installation of a flipper costs only about $50 but to this must be added the labor cost of operating it. In many localities the flipper can be operated only by the employment of an extra stage hand.

The alternative—a new set of lenses and aperture plates—would cost approximately $200, a very considerable amount to the small theater owner. It is likely that many of these small houses will continue to show their sound-on-film pictures with a blank strip either on one side or on both sides of the screen.

Practically all of the better class or *de luxe* houses fall within classes *A* or *B*. At present the theaters in class *B* probably outnumber those in class *A* but the tendency is definitely toward the spread of the reduced aperture-shorter focal length lens method.

The following example illustrates the rapidly changing conditions and the tendency Electrical Research Products, Inc., undertook on behalf of the Academy a complete survey of the aperture situation in all theaters west of Denver using ERPI equipment. The current practice in 306 theaters was reported by ERPI field representatives. A tabulation of the reports made gave the following results:

Theaters using method A.....	35
Theaters using method B.....	123
Theaters using method C.....	136
Theaters using method D.....	12
Total	306

A few days later a supplementary report gave the following additional information: "Since our last report Fox West Coast Theatres has decided to equip all of its theatres with the proportional masks and change of lenses. Publix Theatres, Inc., are also doing this in all of their theaters in the western part of the country, except those of the Marcus enterprises, recently acquired. These new developments would raise the number of theatres first reported as using method *A* from 35 to at least 100.

Recentering Methods

Probably the most difficult problem in connection with the reduced aperture method (*A*) is to recenter the picture after it has been enlarged. The amount masked out from the top and bottom of the picture in reducing the aperture is calculated to balance the increased magnification so that from the standpoint of height the picture will fit into the screen frame. Magnification extends the left margin of the picture to cover about half of the blank strip. The right margin is extended an equal amount beyond

* A paper included in the *Technical Digest* of the Academy of Motion Picture Arts and Sciences.

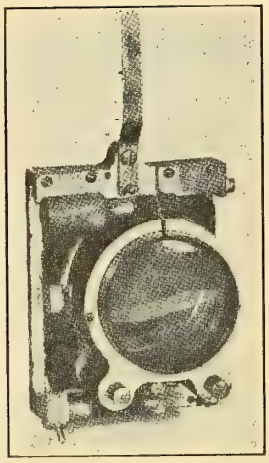


Fig. 2. Adjustable lens mount for centering undersized aperture, as developed by Publix

the black border so that the picture must be moved to the left in order to be properly centered. Standard equipment now in use does not provide for this need. Movement of the picture from left to right is not possible due to the stationary base which gives a fixed position to the projection machine.

There are two ways in which recentering may be accomplished, both involving the use of auxiliary devices. The first and most common method of recentering is by moving the lens slightly to the left. Publix theaters use a lever-operated, horizontally movable lens mount (Fig. 2) which moves the optical center of the lens 0.080 in. to the left. This introduces spherical aberration which is sometimes noticeable on the screen but usually not enough to be considered a defect. An "Ilex" lens has been developed with optical corrections permitting sharp definition at two focal lengths, thus simplifying the procedure by eliminating the necessity of actual lens changing. The second method of recentering is by use of a device which makes it possible to move the equipment on the horizontal plane. A lever at the front moves the front end of the machine laterally to preset stops.

The newest development which promises a satisfactory solution to the problem is a shifting device (Fig. 3) developed by the Bell Laboratories for the ERPI reproducer set for the specific purpose of centering small aperture pictures on the screen.

ERPI Shifting Device

The shifting device consists primarily of these two units: a pivot plate for the forward pair of legs, and a plate incorporating a pedal mechanism for the rear pair of legs. Provisions are made for anchoring the foot pads of the reproducer set to these units, which in turn are bolted securely to the floor. By proper adjustment of the stop screws on the foot pedal mechanism a full sized picture is centered by depressing the right hand pedal until further motion is halted by the adjustable stop, and the smaller picture is centered by depressing the left hand pedal. The locking device, which consists of a quick release screw clamp, maintains either position and assures the picture remaining centered. Briefly, the device permits the operator to quickly center either sized picture at will and maintain that position constantly.

Other Aspects

Attention has been called to several other aspects of the reduced aperture practice.

1. The shorter focal length lens increases the graininess of the picture on the screen. No theater reported this as a serious defect.

2. One theater chain called attention to the fact that the smaller aperture slightly reduces the amount of light that gets to the screen. Due to the fact that the size of the picture is increased, this reduced light must cover a larger screen area. However, there has been no indication that this constitutes a serious problem.

3. The projectionist's problem of keeping his picture in the frame is more difficult and requires painstaking care. Although the cameraman may keep his action within the smaller area he usually fills up the balance of the frame with foreground and background for the benefit of theaters using the standard aperture. This means that the projectionist finds no indication on the picture as to the exact line of its upper and lower limits. More is dependent upon his own judgment than formerly and his responsibilities are greater.

Summary of Data

The facts summarized above were presented at a joint meeting of the Technicians' Branch of the Academy of Motion Picture Arts and Sciences with the American Society of Cinematographers and the local chapters of the Society of Motion Picture Engineers and the American Projection Society. After an extended discussion the meeting decided to refer the survey data to a joint committee composed of representatives of the four organizations. This joint committee was constituted as follows: Gerald F. Rackett, John Arnold, E. W. Anderson, Sidney Burton, Albert Feinstein, John F. Seitz, J. F. Westerberg.

At a second joint meeting of these four societies the joint committee reported the recommendations embodied in the following resolution, which was adopted by unanimous vote of the four societies.

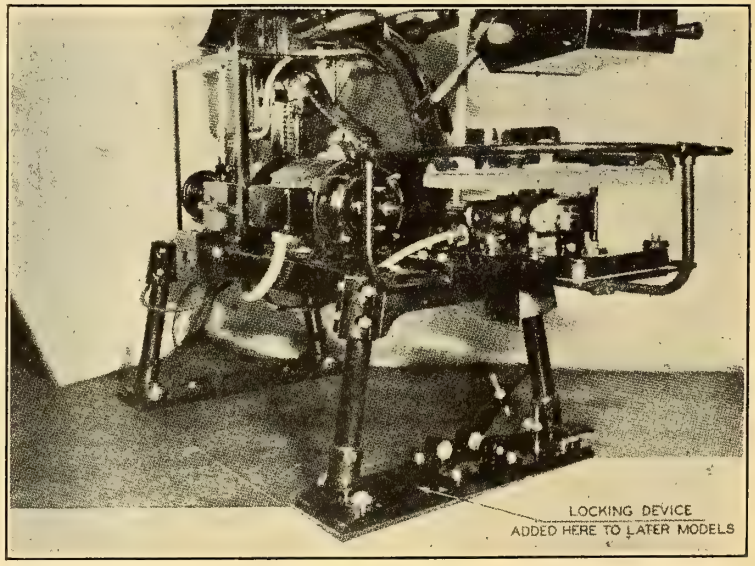
WHEREAS, investigation has revealed wide variance in theater projection practices and that there is no effective standard aperture for projection of sound-on-film talking motion pictures:

Be it Resolved: That as a temporary measure this committee recommends that all studios and cinematographers using sound-on-film methods make marks on the camera ground glass equally spaced from the top and bottom in addition to the mat or mark for the sound track; these marks to delineate a rectangle 0.620 by 0.835 inch in size and that all vital portions of the picture be composed within these limits.

Be it also Resolved: That the committee further recommends that theaters which make a practice of reëstablishing the full screen proportions from sound-on-film pictures do so by the use of an aperture whose size would be 0.600 by 0.800 inch on the basis of projection on the level, the horizontal center of the aperture coinciding with the horizontal center of the S. M. P. E. Standard Aperture.

Studio Cooperation

Copies of this resolution have been sent to executives of all motion pic-



Screen centering base which has been incorporated in new models of ERPI Universal Base

ture studios and leading theater chains. The following Hollywood studios have already reported that marking would be made on the ground glass of all cameras in accordance with the specifications contained in the resolution: Paramount-Famous-Lasky, Metro-Goldwyn-Mayer, United Artists, Pathé, Universal, R-K-O, Tiffany-Stahl, Mack Sennett, Darmour and Educational. Present markings on Fox Studio cameras approximate the recommended practice. This assures a uniform practice in the studios that anticipates and is in accord with existing practices in the theaters. The aperture dimension recommended to theaters represents a mean of dimensions reported by theaters now using the smaller aperture and may serve as a guide to theaters which may choose to adopt it in the future.

Copies of this resolution have also been sent to the Standards Committee of the S. M. P. E. and the Projection Advisory Council in the hope that these two important bodies would interest themselves in working out a set of permanent standards to meet the new conditions.

Addenda

The following item, although not a part of this article, I thought might be an interesting sidelight.

A supervising projectionist of one of the largest theater chains in his reply to our inquiry raises a very pertinent question. He says:

"The matting off at the top and bottom of the picture seems essential to members of the profession but the thought occurs to us, 'Does the shape of the projected picture matter to the general public?'" Our curiosity aroused, we put the question of the comparative advantages of the square and rectangular screen among others, to Dr. Walter R. Miles of Stanford University. Dr. Miles is professor of experimental psychology and an outstanding authority in his field. He was passing through Hollywood on his way east to attend international congresses of physiology and psychology. His comments on the proportions of the screen are given below.

According to the view of Dr. Miles, the physical nature of the eye as well as long habit is against the nearly square shape of the sound-on-film picture for the motion picture image as compared with the rectangular shape silent picture. He says:

"No generation of man is entirely free from former generations. Whether this is accident or intention it is hard to determine. If we make a survey of the tools and household articles that were used in Egypt as compared to those that are used today we find, perhaps to our surprise, considerable uniformity in shapes and sizes. For example, there is an optional size and weight for the hammer that is used in one hand. There is an optimal size and shape for the hand mirror to be used by a woman. Many illustrations of this come to one's mind.

Summary on Theater Projection Aperture Practices

Theater Chain	Report by	Projector Aperture Policy for Sound-on-Film Pictures
Publix Theaters, Inc.	Harry Rubin, Supt. of Projection	Method A standard for all larger houses
Loews, Inc.	Lester B. Isaacs, Supt. of Projection	Method A standard for all larger houses
Fox-West Coast	R. H. McCullough, Supt. of Projection and Electrical Equipment	Method A standard for all houses. About 65 houses already installed
Fox-New England	Herschell Stuart, General Manager	Method B in all houses; if no better improvement, will adopt Method A
Balaban and Katz	J. H. Goldberg, Supt. of Projection	Method A standard for circuit
Warner Brothers-Skouras Bros. Circuit	Charles Skouras, Manager	Method B in all theaters
Saenger Theaters	F. Sander, Mgr. Supply Dept.	Method A standard for circuit for Silent and Vitaphone as well as sound-on-film
Universal Theaters	D. B. Lederman, Constr. Dept.	Methods B, C, and D
Commerford Theaters	Edw. W. Parsons, Chief Projectionist	Method A standard for circuit
R. B. R. Amusement Company	J. H. Rowley, Manager	Methods B, C and D
R. & R. Circuit	B. L. Brockman, Mgr.	Methods B, C and D
R. C. A. equipped theaters (R-K-O, *etc.*)	M. C. Batsil, Chief Engineer	Method B standard for all houses Method A in not more than 5 per cent
E. R. P. I. equipped theaters in Western U. S. A. (306 theaters)	Nathan Levinson, W. Division Manager	Out of 306 theaters about one-third use Method A; about one-third Method B; and about one-third Methods C and D

Method A—Combination of reduced aperture with shorter focal length lens.
Method B—Movable mask or flipper
Method C—Blank strip on the left side of picture.
Method D—Small blank strip on each side of the picture.

8 to 5 Rectangle Posed

"The proportions of the rectangle have been a subject of scientific study since about 1875. At that time it was noted that man, in using the rectangle in nearly all of his buildings, furniture, and conveniences, adopted a ratio which was strikingly different from the perfect square. Although there is no correct exactness in this ratio it tends to be about five to eight, a combination which has been called the golden cut, frequently found in crosses, windows, *et cetera*. The formula has been: the short side is to the long side as the long one is to the sum of the two. This must not be regarded as a law to be striven for or which will bring punishment if it is transgressed.

"If we seek for a basis in the physiology of the eyes and in the psychology of perception the following points come to our notice. The eyes have one pair of muscles for moving them in the horizontal but two pairs for moving them in the vertical. Vertical movements are harder to make over a wide visual angle. As man has lived in his natural environment he has usually been forced to perceive more objects arranged in the horizontal than in the vertical. This has apparently established a very deep-seated habit which operates throughout his visual perception. Perhaps we can see the whole thing typified in the opening through which the human eye looks; it is characteristically much wider than it is high.

"One final feature in the psychology of visual perception is that the vertical axis is overestimated. A true square looks about three units too high.

"We therefore see conformity with man's general experience as well as with the accepted art practice in projecting a picture that is wider than it is tall."

Upon his return from the east Dr. Miles took pains to reassure us that some of the leading physiologists and psychologists of the world with whom he had discussed this very interesting subject had in general confirmed his opinions. This is very interesting especially in view of the fact that the proportions of some of the wide films in use are two to one and the opinion expressed by Dr. Miles gave eight to five as the proportion for maximum efficiency.

A New Sound Picture Laboratory

By H. S. PRICE
Member of the Technical Staff, Bell Telephone Laboratories

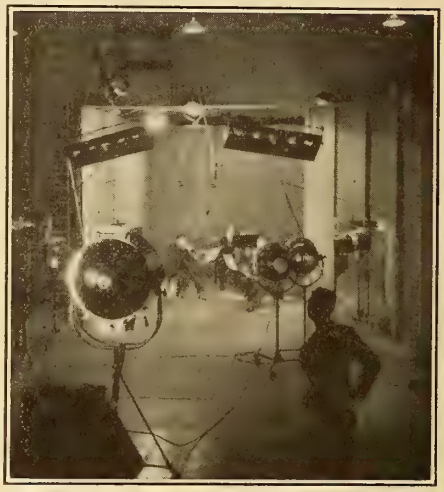
TO provide facilities for making experimental sound pictures under conditions similar to those in practice, but with full opportunity to vary conditions or otherwise efficiently do development work, a sound picture laboratory has been built and equipped by Bell Telephone Laboratories. Located at 151 Bank Street, New York City, the building occupies a frontage of 49 feet and has a depth of 118 feet. Within this three-story building is a soundproof stage and a monitoring room, with a control balcony between them. Technical equipment comprises a single recording channel with its complement of both film and disc records, and complete power equipment; facilities for developing and printing by continuous processing machines; a review room with completely equipped projection room; and laboratories for research and development work in transmission, photography, and optics.

Air Washer and Humidity Control

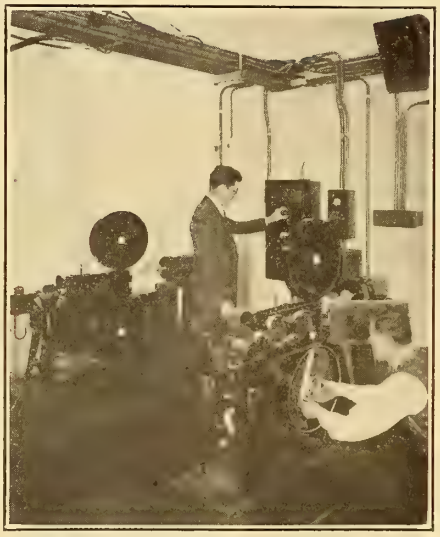
Requirements for film processing, and the necessity for a sound-proof stage and monitor room, made air conditioning and ventilation necessary, so that a comprehensive system has been installed not only for temperature regulation and ventilation but for humidity control as well. On the first floor is the air conditioning plant consisting of air washers, blowers, a refrigerating machine, and accessory apparatus. All the heavy equipment is mounted on separate foundations to prevent vibration being transmitted to the building structure. Ventilating ducts, with subdividing partitions and baffles to avoid the transmission of machine noises or sounds from one room to another, extend to all parts of the building.

Dust is removed by an air washer, and during hot weather the water pumped to it is artificially cooled to bring the entering air to the required temperature. Steam coils are mounted in the ducts just ahead of all outlets, and thermostats mounted on the walls of the rooms control the steam admitted. Humidity for most parts of the building is held around 55 per cent, but separate control is provided for film processing where a humidity of 70 per cent is desired for printing and 35 per cent for drying.

Omitting the stairwell, the third floor is divided into three unequal parts by transverse walls. The sound stage occupies the 70 feet at the rear, for the full width of the building, and is acoustically treated to provide the proper conditions for recording. On both side walls are power outlets for stage lighting, provided by large incandescent units—some of them using 5,000-watt lamps. Other outlets are for microphones, for camera motors, and for an extensive signalling and inter-communication system.



The sound stage during a "take"

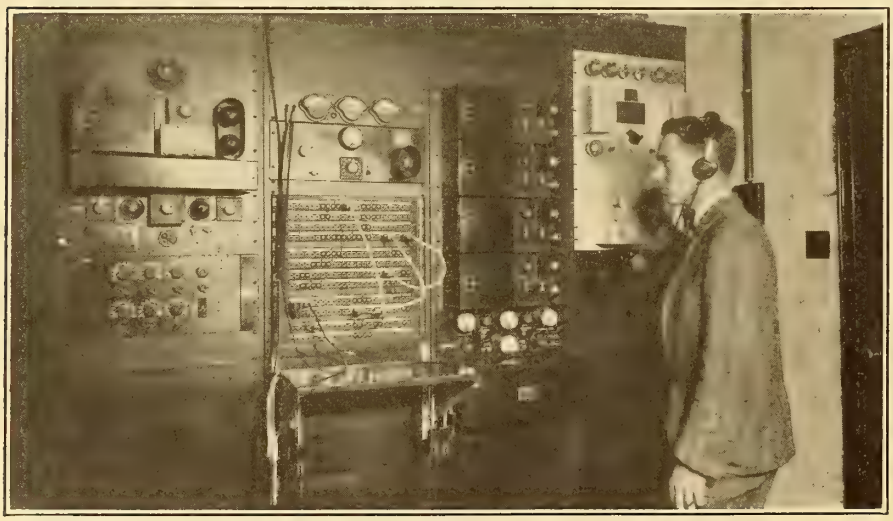


Two film recording machines

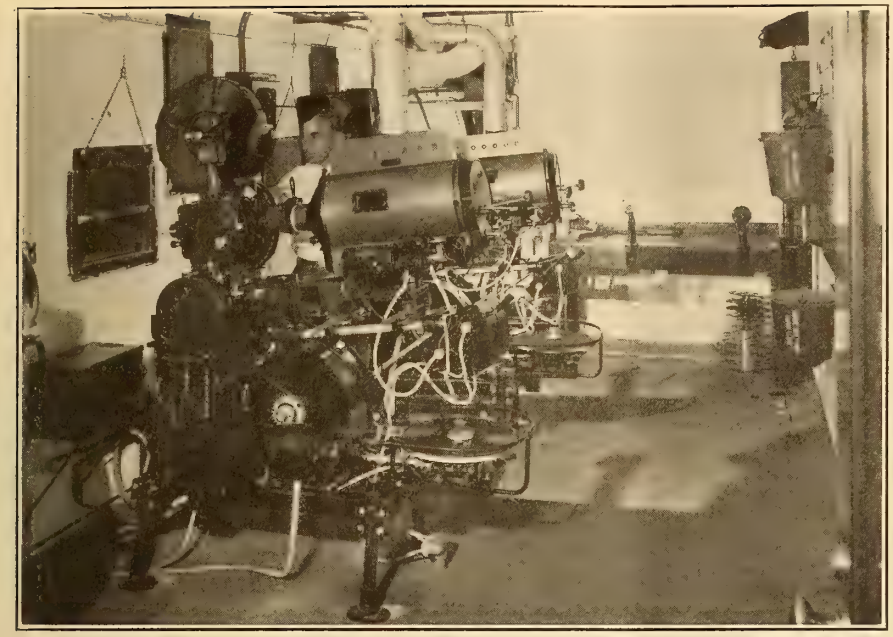
Sets will be erected, for the most part, at the north end of the stage where they will be visible from the window of the monitoring balcony in front of the south wall of the stage. There a monitor will sit, while recording is being done, at a table on which is complete control apparatus for adjusting the intensity of the "pick-up" from the microphones on the stage; a volume control and indicator; signal lamps; and inter-communicating equipment.

This monitoring balcony is above the narrow central division of the third floor. Beneath it is a projection room to be used for "scoring." Here pictures for which a musical program is to be recorded will be projected through double-glass windows to a screen on the stage. The motors of the projectors will be synchronized with the disc and film recorders on the floor below, and an orchestra on the stage will play the score for recording in synchronism with the picture being displayed before them.

The front part of the third floor is the monitoring room which is open to the monitoring balcony. This room is treated acoustically to provide good listening conditions, and the usual sound projector units are mounted on movable towers to facilitate obtaining the desired results. In this room the director and cast may listen to the scene just taken as it is played back from one of the waxes. During



A transmission measuring position is mounted on these racks in addition to monitoring, bridging and main amplifiers



In the projection room are two standard projectors and space for a third for experimental purposes

the taking of a scene the monitor observes the action through the window in front of the control table, and hears the sound through these horns, which he may connect at will either to the amplifier bus ahead of the recorders or to the monitoring photo electric cell amplifier on either of the film recorders.

The Recording Laboratories

The second floor is devoted mainly to recording laboratories and general office space. Here too are dressing rooms for the performers, and power and battery rooms. The recording channel from the monitoring balcony comes first to the amplifier room where are located the main amplifier and the bridging amplifiers for each of the recorders. Here also are the monitoring amplifiers as well as testing apparatus and the patching sections which give free interchange of apparatus and circuits.

Disc and film recording each have their own room; the one with two wax recorders and the other with two film recorders. The proposed plan, here as throughout the building, is to maintain one complete set of equipment for standard recording under current conditions, and another for experimental work. New apparatus will be tried out in this laboratory before being recommended for commercial service.

Duplicate test system, recorder lamp and condenser transmitter batteries, providing 24, 12 and 6 volt supplies, are installed in the battery room in addition to duplicate plate batteries tapped to furnish 350, 250, and 130 volt service.

In the power room are two charging generators, one of 12 volts and one of 72 volts. All batteries are subdivided when necessary to charge at one of these voltages. In this room also—in addition to the power switchboard—are two distributors for synchronizing the motors on cameras and



Intermediate amplifier and monitor's control desk facing observation window

recorders, and the sensitive speed control apparatus. The distributors are operated from the recording rooms by remote control apparatus.

Also on the second floor there is a temporary rack-and-tank developing room where small quantities of experimental films may be processed. A motor-driven drying rack—a large circular frame built of narrow slats on which the film is wound and rotated—allows rapid and convenient drying. At a later date this equipment will be removed and the space will be used for an optical laboratory.

On the first floor, in addition to the administrative offices, review room, and air-conditioning room, are located the continuous film-processing machines. Of the two equipments one may be used for developing negative film and one for positive film, or one for standard and the other for experimental work. Each can process 20,000 feet of film in a day so that ample capacity is assured. In addition there will be a printing room with two continuous printers. On the roof of the building is a fire-proof film vault where the nitrate film may be safely stored.

An important feature of the installation is the signalling and announcing system. On the monitoring table in the gallery is a microphone and a set of keys so that the monitor can talk through loud-speaking projector units to the stage or to any of the recording rooms. Inter-phones, giving two-way communication between all operating points, are also available. On the stage is a portable signal position for the director. It is a small table with an interphone and a signal panel. Similar signal panels are on the monitor man's desk, and on the walls of each recording room.

As each of the recording rooms become ready, its lamp in all of the panels is lighted. The distributor is then started and when it is up to speed, a man at one of the recording positions lights a "master start" lamp, and the taking of the scene begins.



Soundproof studio. The monitor's position may be seen through the square window at one end of sound stage

Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

MANY projectionists are now classed as technicians and are able to keep the show going, in case the sound equipment ceases to function. However, there are many who lack confidence because of insufficient knowledge. It is our desire to furnish you with such information that will be of value and assistance to you in keeping the show going and make the proper adjustments to produce the best sound reproduction. We are focusing our attention on sound efficiency, and it is up to you to follow.

Technicians and Servicemen are at your service, and you, along with those enginers, are responsible for the rapid strides in the successful development of sound pictures. We gradually grow stronger as our knowledge increases. Sound equipment represents a huge investment. Operation, maintenance and service for upkeep is a great added expense. Profits in many instances have been insufficient to cover this added expenditure.

The present sound equipment is not perfect. New developments are anticipated. We must meet their requirements. Additions in the future will be made without scrapping much of the present equipment, but all of these new additions will be at the theatre owner's expense.

Shutting Down Amplifier

Here are important directions that should be followed carefully each time the amplifier system is shut down.

(1) In shutting down the amplifier equipment, always turn off the horn safety switch first.

(2) Turn off the 41-A, 42-A and 43-A starting switches.

(3) Turn off the Power Safety Switch.

(4) Always set the film-disc transfer switch at "off" position when system is not in use.

(5) Turn off the battery switches on the switching panel.

Theatres using the 41-A, 42-A or 43-A amplifiers should use the following as a standard for starting and shutting down amplifier equipment:

(1) Storage Battery switches should be in operating position.

(2) Close safety Power Switch.

(3) Turn snap switches on 42-A and 43-A amplifiers to "Fil," (which lights filaments).

(4) On the 41-A amplifier, before lighting the filaments, turn the filament control rheostat to Zero, then turn the filament key switch on and bring the filament rheostat to 270 milliamperes.

(5) After the filaments of the tubes in the 42-A and 43-A amplifiers have heated up for about 5 minutes turn the snap switch from "Fil" to plate. Remember that the 42-A amplifier supplies plate potential to the 41-A amplifier. On the 42-A and 43-A amplifiers each meter point should be within the red mark limits.

(6) The 41-A amplifier has three 239-A vacuum tubes. It is extremely important that these tubes be checked daily for plate current reading. Each 239-A vacuum tube should be tested as follows: Press in turn the three buttons marked "Plate Current." Meter marked "Plate Current" should read in each case not less than 1.35 nor more than 1.55 milliamperes. Vary the filament current, between the limits of 220 milliamperes and 270 milliamperes and in each case that a 239-A tube falls below the value of 1.35 milliamperes, replace the tube so as to avoid distorted output.

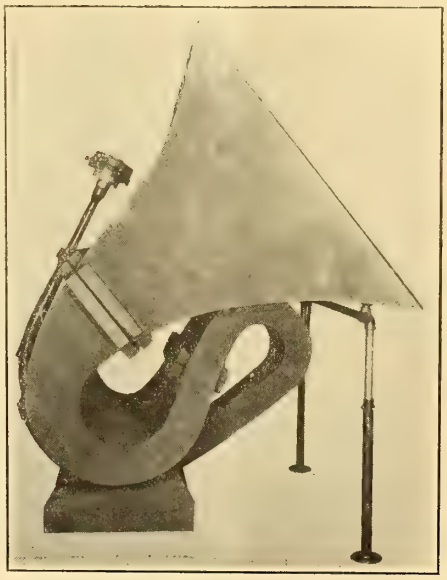
(7) The 42-A amplifier has four 205-D vacuum tubes. It is very important that the two Rectifier Tubes and the two Amplifier Tubes be balanced. Remove one of the amplifier tubes and observe the plate current value. Replace this amplifier tube and remove the remaining one. Observe the plate current value. The plate current values of both amplifier tubes should be within 5 milliamperes of each other. If these values do not come within these limits, select a tube from the spare supply and save the tube removed, label with the plate current value and place in the spare parts cabinet until you can balance this tube with another tube at a later date.

The two 205-D Rectifier Tubes should be balanced in the same manner as the amplifier tubes. It should be understood that the rectifier and amplifier tubes give a combined plate reading within the red limits inscribed on the face of the plate current milliameter.

(8) The 43-A amplifier has four 211-E vacuum tubes. Remove one of the 211-E amplifier tubes and observe the plate current value, replace this amplifier tube and remove the remaining one. Observe the plate current value. The two plate current values should be within 10 milliamperes of each other. If they are not within these values, select one from the spare supply, which will give an indicated value within the required limits. In cases where it is necessary to remove a tube from the amplifier, because of difficulty in obtaining proper balancing, the tube removed should be labeled with the indicated value and placed in the space parts cabinet until it can be balanced with another tube at a later date. The 211-E Rectifier tubes should be tested in the same manner as the amplifier tubes.

(9) The last thing, which should be done before starting up the amplifier system, is to turn on the Horn Safety Switch.

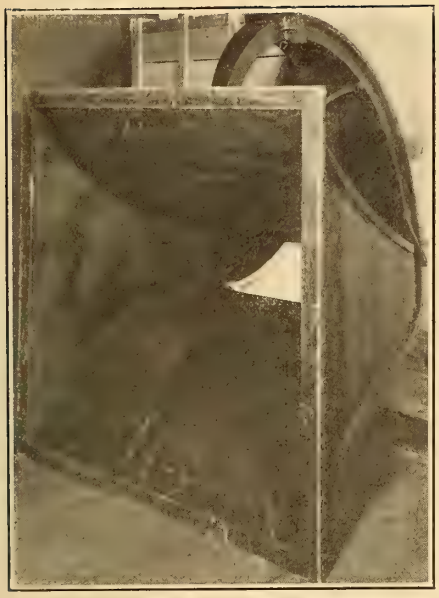
Exponential Type Horns



Side view of 13-A horn

WESTERN ELECTRIC supply exponential horns with all sound projectors system installations. With the first installations the 12-A and 13-A horns were supplied. The 15-A and 15-B type horns have been installed with all installations during the last year. These new horns are much lighter in weight, but occupy more space.

The Bell Laboratories place three layers of white flannel inside the 15-A and 15-B type horns near the output of the air column. We have found that this flannel absorbs many high frequencies. By removing this flannel, sound reproduction in many theatres has been improved. Early installations employed two upper and two lower horns, but now with similar installations two and three horns are installed alongside each other about two-thirds height of the screen. The 12-A, 13-A and 15-A type horns have single throats, whereas the 15-



15-A and 15-B horn

B type horns have two throats for two units and replaces the 12-A and 13-A type horns.

The air column on these horns must be small in area at the input end to place an appreciable pressure-load on the diaphragm, and it must be large at the other end to radiate the sound effectively into the free air. For best results the cross sectional area should gradually flare from the small end to the large end according to an exponential curve and mathematical formula. The 555-W Western Electric Receiver should never be used without the horn. Without the horn sound will not come forth with full resonance and amplification. The receiver does carry the sound, but it is unable to transmit it without the horn.

Acoustical Considerations

Acoustical conditions in theatres must be taken into consideration, for good sound reproduction. When sound comes from an exponential horn, sound waves spread at angle of 45 degrees with a directional effect and the speed of these sound waves is about 1,100 feet per second. In a small fraction of a second these waves strike the walls, ceiling and floor of the auditorium. Some of the sound waves are reflected back into the room and some are absorbed by the surfaces they strike. Ordinary plaster, glass or wood surfaces absorb only about three per cent of the sound, leaving ninety-seven per cent to be reflected back into the room, to repeat the action of the original sound wave.

One of the chief complaints about "Talkies" is that the dialogue cannot be understood. It is important that talking picture theatres have a short period of reverberation. One might use the comparison of throwing a golf ball against the wall of a room having concrete walls, ceiling and floor. The golf ball would bounce from the hard wall with almost all of its original force. A small portion of its energy is absorbed by the concrete, but this ball would keep bouncing in the room for many seconds. If we would throw the ball against an absorbing surface, such as Ozite or velour drapes, the ball would not bounce with its original force, as it did when thrown against a concrete wall.

Reverberation Period

The action of sound is similar, in that the original sound continues to be reflected back and forth in the room after the actual source has stopped, and may be audible for several seconds. This continued reflection from one hard surface to another produces a lingering trail of sound, which is termed "reverberation." Sometimes the sustaining sound is called "echo" instead of reverberation.

This is not strictly accurate, as the term echo is used to denote a sharp, which is distinct repetition of sound instead of the continuation of it. If sound lasts in a room five seconds after its source has ceased, it is said to have a "period of reverberation" of five seconds. It is evident that if the period of reverberation or the length of time that sound lasts in a room, is several seconds and a speaker utters from three to five syllables per second, the audience will hear a mass of syllables, from which they are expected to distinguish only the last one spoken. The human ear is not sufficiently acute to do this and in spite of straining, only a jumble of unintelligible sound is heard.

Correcting the acoustical condition of a theatre, by installing sound absorbing material will reduce the reverberation time. The amount of this material depends entirely upon the size and shape of the auditorium and the original surface. Hearing must be easy and natural, without straining on the part of listeners.

Sound reproduction in theatres must be reproduced much louder than the natural voice, which means that the sound lasts longer and if the side and back walls, and ceiling have reflective surfaces, the reverberation will be greater. To obtain the complete sense of the dialogue it is necessary that every syllable be distinct, but one can follow the rhythm and melody of music even though separate notes are indistinguishable. Most theatres are satisfactory in regard to size and design, and the exponential horns and units can be adjusted to give the degree of loudness required.

Other Factors

While there are other factors influencing acoustical conditions in addition to reverberation, such as the size and shape of the auditorium, the loudness of reproduced sound, and the presence of interfering noise, reverberation is the one requiring adjustment in many theatres. Noises arising from street traffic, projection room equipment and the ventilating equipment can usually be quieted. Many sound absorbing materials will absorb the high frequencies, which is detrimental to sound reproduction. Before any acoustical treatment is applied to correct reverberation, it is very essential that an acoustical expert be consulted, who can accurately plan the correction of the acoustical problems with a minimum amount of expense.

Western Electric 8-B Amplifier

THE 8-B amplifier is a very popular amplifier among veteran sound projectionists. Up-to-date improvements have set aside this amplifier. However, the 8-B Amplifier will still hold its own for good clear speech amplification alongside the present new equipments.

This amplifier is a speech amplifier and is used to amplify feeble currents directly from the Fader. It is mounted on a rack, similar to recent installations. It is a three-stage impedance coupled amplifier. The first stage uses a 102 type tube and the second and third stages use two 205-D tubes. A jack panel is provided on the amplifier for measuring the filament and plate currents of the tubes.

Sources of Power

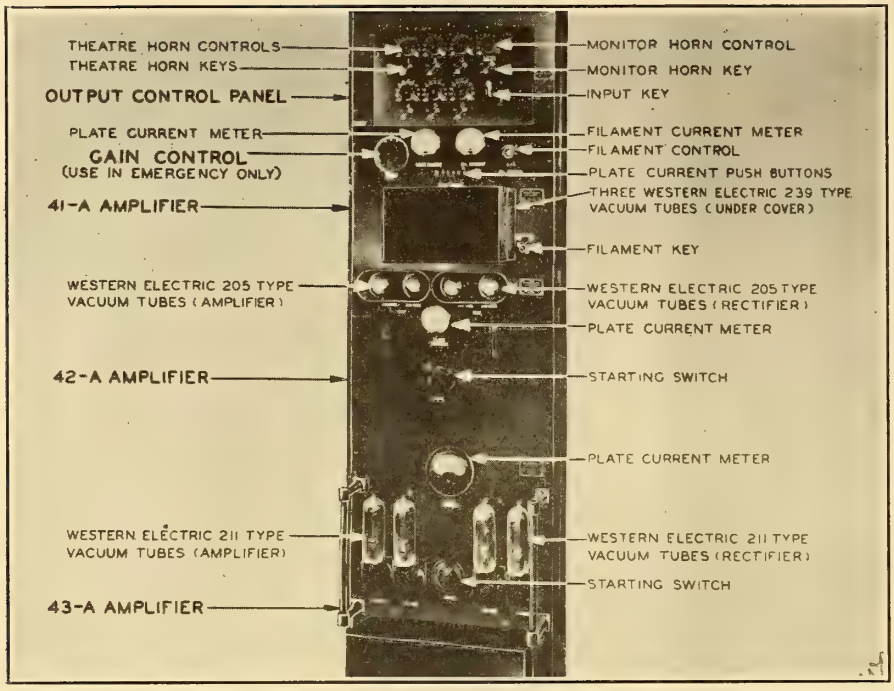
There are two sources of DC power needed for this amplifier. One is twelve volts for the filaments of the vacuum tubes and the other is a high voltage source with a tap of 130 volts and 350 volts for the plates of the vacuum tubes. Motor generator sets and rectifiers have been installed in many theatres to replace the "B" batteries which furnish the plate potential.

The plate potential of the first two stages of amplification is 130 volts—the last stage is 350 volts. The first stage negative grid potential is obtained by the voltage drop in a resistance. The second and third stages are supplied with negative grid potential from six 703 dry cell batteries. This amplifier is designed to work from an impedance of 200 ohms. The output is designed to be matched to various equipments. The gain of this amplifier is controlled by a 22 point potentiometer, which operates on the first and second stages to vary the gain from minimum to maximum with steps of three Decibel each.

The filament current of the 102 type tube can be adjusted by the rheostat marked filament No. 1 and the filament currents of the two 205-D tubes can be adjusted by the rheostat marked filament 2 and 3.

Tube Filament Values

The 102 type tube filament is connected in parallel. The two 205-D



W. E. 200-A panel. The horn panel is shown at top, then the 41-A, 42-A and 43-A amplifiers

tube filaments are connected in series. To measure the current requirements, first throw A and B battery switches on operating position. Then, turn on the snap switch marked "filament" on power panel. Measure the filament currents by inserting the smaller of the two plugs attached to the cords of the meter panel to jack marked "Fil. 1," which is connected to the filament circuit of the 102 type tube, which should be adjusted to .97 plus or minus .03 amp. Insert the plug in jack marked "Fil. 2-3," which is connected in the filament circuit of the 205-D vacuum tubes, which current should be adjusted to 1.55 plus or minus .05 amps.

Plate Current Values

After measuring the tube filament values, it is necessary to measure the plate current values. Turn on snap switch marked plate—insert the larger of the two plugs into the proper jacks. The three jacks are connected in the plate circuits of the corresponding tubes and the plate current should read as follows:

Plate current #1 tube—0.5 to 1.0 Mills.

Plate current #2 tube—5 to 8 Mills.

Plate current #3 tube—15 to 28 Mills.

These are all tested from the 514-A meter panel.

Fuses

The back of the 8-B Amplifier has a sheet metal cover, which can be pulled off and which is used to protect the component parts. After removing the cover, you will find fuses, which consist of 62-B fuse (0.25 ampere, glass tube) in the plate circuit and a 3-ampere cartridge fuse in the filament circuit. It, at any time, singing is developed in the 8-B amplifier it will usually be found due to a bad negative "C" battery. The plate current of the 205-D tubes will usually be high when you have trouble.

Volume Control

It is estimated that approximately 55,000 deaf mutes are in the United States and more than twenty million women, men and children suffer from some degree of deafness. Many thousands in this great number are unaware of their affliction. The pleasure and value are stripped away, because of their inability to distinguish the jumbled sounds that batter their ears. The physical condition of a person has considerable to do with the ability to hear well. Persons who cannot hear well will resent being called deaf just as anyone wearing glasses would resent being called blind.

I, personally, visit many theatres and often find the volume above normal hearing and the person who is controlling the volume thought it was entirely satisfactory. The person controlling the volume in your theatre must have good sound judgment. He must be in good health and have no defects in hearing.

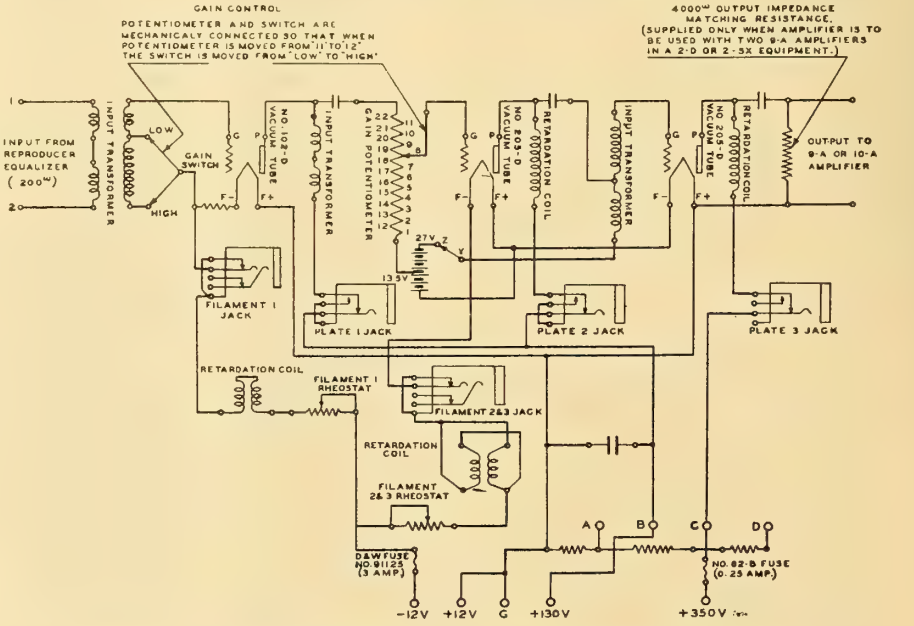
Normal speaking voices should be no louder than is required to enable a quiet audience to hear distinctly. With the advent of sound pictures many of the "hard of hearing" sent petitions to studios not to abandon silent pictures. In answer to these entreaties, many theatres have installed special headsets, which enables the deafened to hear all the sound and dialogue.

The Audiometer

Electrical Research Products, Inc., have an audiometer at each Divisional office for the purpose of testing hearing. Upon request they will be glad to give you a test. This instrument resembles a miniature radio set, and has a scale of eight notes, each of which can be decreased in volume until the listener no longer hears any sound. This latter point indicates the person's "threshold of audibility," which varies with good and bad hearing. It is imperative for everyone connected with the presentation of sound pictures to have an audiometer test of their hearing, so that the best sound picture performance can be presented without criticism on part of the patron not being able to hear well.

Fundamentals

Each month we are going to hark back to the basic principles in order to familiarize you with the funda-



Schematic of W. E. 8-B amplifier which gives a comprehensive understanding of how various units are hooked together

mentals of sound reproduction in the theatre. A part of this page will be given up each issue to these instructions. It is our belief there are certain advantages in this—even though it may be a rehearsal for many of the projectionists, still it is possible these well versed men may have assistants who can stand a little instruction now and then, and this will be a short cut.

Each month a different phase of sound from its initial important phases will be touched upon. This week we give you an illustration of amplifier symbols.

Standard Symbols

One of the best ways to familiarize yourself with amplifier circuit diagrams is to learn standard symbols. Supposing one projectionist wanted to explain an amplifier circuit to someone else—that is, tell how many tubes were used and how they were connected; what battery or power connections were made and whether it used transformer or resistance coupled stages.

If he desired he could orally describe or perhaps write a lengthy description of the circuit employed, but the quicker way would be to graphically depict the various pieces of apparatus employed and show how they were connected to form a complete circuit. In amplifiers, a circuit diagram constitutes a short cut, which conveys easily the message to an individual. Constructional information is what is needed in the field to insure proper operation. It is necessary that as an aid in learning how to draw symbols, you memorize a few at a time, then draw them from memory and compare your work with the symbol chart.

W. E. 7-A Equalizer

The western 7-A equalizer is located directly underneath the turntable of the Western Electric Universal Base. The purpose of the equalizer is to remove certain scratch noises, which are inherent in disc reproduction. When the equalizer is installed in the reproducer circuit, certain high frequencies are eliminated from speech and music, which is objectionable.

The equalizer is an electrical bridge connected directly across the output leads of the reproducer. Resistances are connected in series between terminals 1 and 2, and 2 and 3. Between terminals 3 and 4, there is employed a choke coil and a condenser. Connections may be made between any of the 3 points, thereby giving varying degrees of equalization. Terminal 4 should always be connected to the fader side of the circuit.

The other side of the circuit must be connected to terminals 1, 2 or 3, whichever terminal is most effective in eliminating the surface noise. If the equalizer is connected on terminals 1 and 4, you get the maximum amount of resistance with the minimum equalization. Terminals 3 and 4 give the greatest high frequency attenuation with maximum equalization.

The equalizer will reduce the volume somewhat and will remove many high frequencies, which will remove sibilants and over-tones, which are in the higher ranges.

However, the question is, what is most perceptible to the theatre patrons, the elimination of the high frequencies, or the presence of scratch noise. We have to form a comparison and compromise between the high frequencies and the scratch noise. That is the reason for the different steps on the equalizer.

It is advisable that the equalizer be left out of the reproducer circuit except in such cases where the scratch noise is objectionable. Disc recording is now coming through much better. It is essential that disc reproduction have the maximum high frequencies.

Fader Cue Sheets

The opening of any new picture is an important event. The projectionists are handling the equipment to the best of their ability and the entire show is in their hands. However, the manager is responsible for the general effects in the theatre. It is gratifying to visit a theatre and witness a sound program, which is run efficiently.

It is presumed that most every theatre uses the so-called Fader cue sheet. However, I do believe some theatres call this a useless method and they would much rather let the sound suffer. If someone does complain about the sound, it is immediately blamed on the sound equipment or the acoustics. Many useless surveys are made on this account and many dollars are wasted in overtime because of someone's alibi.

The fader cue sheet is an important item for the proper presentation of sound pictures. It supplies the projectionist minute details concerning certain changes in volume, instead of his having to wait until the signal comes from the observer in the audience. Arrange a fader cue sheet for every subject, regardless of length.

Observer Cooperation

It is necessary for the manager or observer to be present at all rehearsals. If your theatre does not have any rehearsals, take the first show for example. The projectionist and the observer should be provided with pads and pencils. At the beginning of the subject, the observer should have the fader setting and the projectionist should also make a note of the setting. At certain places during the subject the volume will have to be increased or decreased. A direct cue should be taken and marked down, so that the projectionist can automatically take care of this on the next showing.

He should visit the projection room after the first showing and compare notes with the projectionist about the fader cues. A fader cue sheet is just as important as the changeover cue sheet. You will find this cue sheet method of checking your shows will give you a finished performance.

"What Electricity Is Not"

THAT an entirely new language will be necessary before we can truly say what electricity is, or for that matter express in terms other than mathematical the concepts of our modern physical philosophy, was the opinion voiced by Professor Vladimir Karapetoff, one of America's foremost electrical engineers, in a lecture on "What Electricity Is Not" recently before the combined membership of the New York Electrical Society and the New York Section, American Institute of Electrical Engineers.

This future language, according to the speaker, who is Professor of Electrical Engineering at Cornell University and consulting engineer to several large corporations, must transcend our present limited modes of expression—mathematics, speech, or pictures—by means of which we are attempting in vain to present a concept of physics and physical forces mechanically or by analogy. Only some super-human being could speak this unknown language at present; and were he to attempt an explanation of electricity, we could not understand him.

"Electricity is analogous to nothing else in the material world that we know anything about," the speaker went on. "According to our present idea, it is really comprised of three apparently independent entities —negatively charged particles, or electrons; positively charged particles, such as alpha rays, protons, clusters, etc.; and various types of electro-magnetic radiations, as gamma rays, X-rays, and cosmic rays. From some recent experiments we have been led to the belief that under certain conditions the particles behave somewhat like electro-magnetic pulses; and conversely, there is some evidence to indicate that electro-magnetic radiations may display properties of the discrete particles. In other words, all three manifestations of electricity seem to be endowed simultaneously with inertia and charge, to be found in material objects, and with some wave properties such as frequency and wave length, as ascribed to ethereal or non-material oscillations. So electricity becomes neither flesh, fowl, nor good red herring, but something entirely apart. It is for this reason that a new terminology is needed."

That physical science and meta-

physics are definitely interrelated seems evident to Professor Karapetoff, especially in view of this line of negative reasoning on subjects where it becomes possible to tell what a concept is not, but still not define it.

"The human mind," he said, "is never satisfied with a mere knowledge of facts, but insists always on grouping them and trying to develop some philosophical explanation in general terms, in spite of the argument from the metaphysician and logician that this is hopeless. An expression of this sort, in terms of ultimate realities, would call for nouns, adjectives, and verbs encompassing and pertaining to ultimate realities. Those words would come as a part of this new language I mention—and which I do not expect to read or hear."

Professor Karapetoff called attention to the positive results of constructive metaphysical thought for the last two thousand years, which had been negligible; and how we were becoming more and more proficient in our critical analysis, showing what matter is not, what the human mind cannot apprehend, etc., without once reaching an expression of these ultimate realities we seek. "Thus," he concluded, "our knowledge of 'what electricity *is not*' overwhelmingly exceeds any inkling we may have of what *it is*. Yet this elimination of erroneous concepts is in itself a very important function of science, for so long as erroneous concepts reign supreme no real progress is possible."

Electrons Probably Divisible

A somewhat revolutionary line of thought, from the standpoint at least of the popular conception of matter structure in which the electron, particle of electricity, has been considered the ultimate indivisible entity or "bundle" of energy or waves, was the assertion of Professor Karapetoff that in all probability this infinitesimal (and theoretical), bit, hundreds of millions of which would not fill a space the size of an ordinary pin head, was still farther divisible.

"We have been accustomed to call the electron the smallest particle of all matter, and to say that it was indivisible—as we did with the atom until that was divided into electrons. Yet we endow the electron with physical properties (perhaps our language error again, of insisting on mechanical analogies), such as radius, mass, axis of spin, electric and magnetic fields, accompanying waves, etc.; and as soon as we do this, allowing it some structure, this structure must be divisible, and those parts must have their structure ad infinitum. So the explanation of the electron only shifts the difficulty one step further along an infinite ladder, and seems to accentuate this inevitable necessity for a so far inconceivable mode of expression if we must arrive at this ultimate reality we all seek."

Speed of Light Exceeded

Another apparently "ultimate" factor which had been disturbed by recent experiments, the lecturer pointed out in discussing the facts and discoveries laying behind his outline of electricity as the probable basis of modern philosophy and metaphysics, was the Einstein equation showing that material particles cannot move at a velocity greater than that of light, which travels at the rate of approximately 186,000 miles a second.

Some recently observed phenomena, he declared, make it necessary to assume that electrons and positive carriers of electricity partake both of the nature of matter and of waves, and that the phase of these waves is propagated at a velocity greater than light. The comforting statement that these waves are not material, and therefore not hindered by material things in their enormous velocities, only brings us to the deeply philosophical problem of how these immaterial waves can manifest themselves by affecting the behavior of material particles. One of the basic problems of the metaphysics student, according to Professor Karapetoff, is to discover the mechanism of interaction between the material and immaterial; and some day he may formulate this new language which will express a dual structure our senses today refuse even to conceive.

The entire history of electricity, from the first observance of frictional electricity, magnetite ore, the discovery of electric current and its action on a permanent magnet, etc., to the work of Maxwell in bringing together light, electricity, and magnetism and the confirmation of this by Hertz, Rowland's experiment showing that an electric charge in motion is equivalent to an electric current and the more recent discoveries, such as vacuum tubes and photo-electricity, were covered by Professor Karapetoff in outlining the underlying facts of his lecture.

L. U. 181 Member Forsakes Flying for Projection

It's a big jump from being a stunt flier to operating a moving picture machine, but George T. Sewell, official projectionist for the Maryland Board of Moving Picture Censors and member of L. U. 181, bridged the span.

"There isn't the kick in seeing a 10-foot kiss on the screen that there is in a 13,000-foot jump from the air," Sewell explained. "However, watching kisses before they are cut by the censors is a lot safer than parachute jumping—and when one gets older, safety counts for something."

Sewell started to fly in 1904 when airplanes and balloons were in swaddling clothes. He had his first chance to pilot a plane at Riverview Park. Later, he became a professional stunt flier.

"I held a record for a balloon drop of 13,000 feet," Sewell said. "Later, when I devoted all my time to parachute work, I made another record, not since broken, of descending from the clouds in a series of 12 parachutes, using one after another as I plunged through space.

"Strange as it may seem, all the stunt fliers with whom I was associated 15 and 20 years ago are dead. I am the last of the old guard.

"If I stick to my post as a movie projectionist, chances are I'll be enjoying life for many years to come. Most of my associates in stunt flying continued to fly after the war and met their deaths through accidents."



A gift on the completion of his twentieth year of service for a Local Union. President Leo F. Barber, L. U. 245, receiving the keys to a new car, the gift of his associates. Mr. Barber is also Secretary of the Lynn, Mass., C. L. U.

Optical Principles of the Bifocal Lens

By BERNARD ROSE*

LOOKING back only a few years the projectionist will remember that very little information could be had from the manufacturer of optical systems. Even such designs as the Petzval objective, known from much literature on the subject for more than eighty years, were guarded as a trade secret. Some firms even went so far as to express the fear that people would know too much, and they actually went out of their ways to oppose any kind of enlightenment, even popular lectures. The same principles were followed by many rulers in many lands who wished their subjects kept in total ignorance; but the system has always failed. The projectionist, when called upon to use a new machine, a new accessory, naturally wants to know as much about that particular item as he can possibly learn—what it is, what it does, how it is made, etc. This article will describe the new Super-Lite bifocal lens.

The optical system used in this construction is the same that has been applied to the Super-Lite for some time now. The slight modifications which had to be applied to adopt the lens to different sources of illumination did not alter the principle on which the system has been constructed. The lens was completed in July, 1922, being the first type of its kind: —two positive elements separated by a distance equal to the focal length.

The accompanying diagram, Fig. A, represents a cross-section of the lens as disclosed in specifications for U. S. Patent No. 1,479,251 of January 1, 1924.

This diagram shows that in producing such a lens just two radii are required, the front combination being ground by means of the radius 82.57, the rear combination by a second radius 41.28, which is one-half the first radius. The basic, idea of this development was to restrict the number of required radii to a minimum, namely, two. It is generally known that often the manufacturer has to supply focal lengths in steps of one-eight of an inch. This means, then, that for almost every new focal length a new set of radii is required, and if a great number of curves are used in the design, as in the Petzval Objective where seven radii are applied, then the manufacturer has to contend with a large amount of equipment.

Economy With Efficiency

This economical feature of cutting down the number of required curves to one-third had to be maintained without even the slightest sacrifice of the corrections:—color, spherical aberration, coma, flatness of field, and distortion. As much as simplicity of construction and the impossibility of misplacing lenses after cleaning may appeal to the projectionist, his main interest should and undoubtedly is the results on the screen, for the projectionist, given good equipment, is wholly responsible for screen results. It would indicate poor judgment on the part of a designer if in trying to simplify a design he should lose sight of the interests of the man who is the final judge of any projection system —and that man is the projectionist.

As mentioned above the Super-Lite lens was the first lens consisting of two doublets of a long overall length and the shortest back focal length to enable the system to pick up as much light as possible. In the last few years some other constructions, some domestic and some foreign, some patented and some not covered by patent, have been following in the footsteps of the Super-Lite. As regards quality, some are poorer, but none are better.

It may be mentioned that the secret of a good lens is not confined to the specifications giving the radii, thicknesses, spacings, and optical characteristics of the glasses used. This can all be worked out on the broad principles expressed in the science of geometrical optics. The major secret is in the manufacture, the selection of material, the care in grinding and polishing, the centering, cementing, mounting, the adjusting, and finally the testing. Just as a general declared that to conduct war he needed "money, money, and more money," so it may be said that to manufacture a perfect system all that is needed is "care, care, and more care."

Having explained the basic principle on which the Super-Lite lens was built, we have to return to Fig. A and study the power of the elements. It will be seen that the equivalent focal length of the front combination is 197.32 mm., and that the E. F. of the rear combination is 99.42 mm. (exactly one-half), and that the E. F. of the complete system is 100 mm. In round numbers we may say that the E. F. of the front combination is twice the E. F. of the system, that the separation and the rear combination are equal to the E. F. of the system, and that the B. F., the distance from the last surface to the film is about one-half the E. F. of the system.

To make the following calculations we may assume that the lenses are "infinitely thin." It is only a fictitious and incorrect designation, but the results obtained thereby are absolutely correct and calculation is very much simplified. Let us denote:

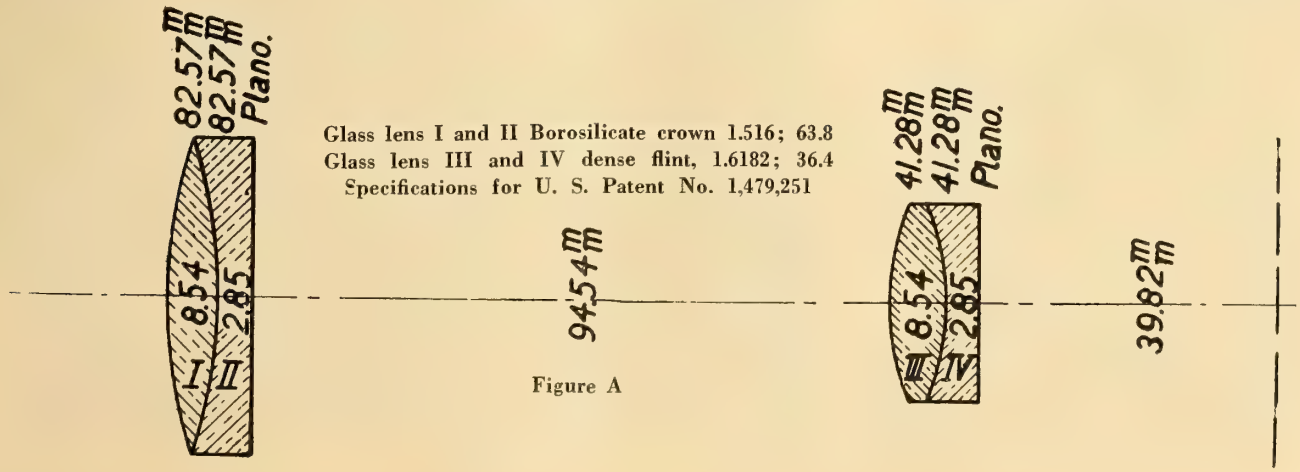
the E. F. of the front combination by $F_1 = 197.82$ mm.

the E. F. of the rear combination by $F_2 = 99.42$ mm.

Δ is the separation of the two lenses $= 100.57$ mm.

Then the equivalent focal length of

* Projection Optics Co.



Glass lens I and II Borosilicate crown 1.516; 63.8
Glass lens III and IV dense flint, 1.6182; 36.4
Specifications for U. S. Patent No. 1,479,251

Figure A

the complete system, E. F. can be calculated by the formula shown in any elementary treatise on optics:

$$\text{E. F.}_{1\text{-}2} = \frac{F_1 \times F_2}{F_1 + F_2 - \Delta} = \frac{197.82 \times 99.42}{197.82 + 99.42 - 100.57} = 100$$

and the back focal length (distance from second lens to the film), which we denote by B. F.:

$$\text{B. F.}_{1\text{-}2} = \frac{F_2 (F_1 - \Delta)}{F_1 + F_2 - \Delta} = \frac{99.42\ (197.82 - 100.57)}{197.82 + 99.42 - 100.57} = 49.15$$

It is evident that by changing the separation Δ we may derive different values for the E. F. and the B. F.

Just for purposes of orientation we may substitute first Δ = O (the two lenses placed in contact), and Δ = 197.82 (the second lens placed in the focal plane of the first one).

The results are as follows:

Δ = 0 E. F. = 66.15 mm.
Δ = 197.82 E. F. = 187.82 mm.
B. F. = 66.15 mm.
B. F. = 0

The reader may ask if anything is as simple as that, whether the projectionist may some day expect a system giving a change in size of the picture three-to-one. This could be done if the requirements for illumination were not as exacting as they are. In other words, a system of this kind would be feasible provided the speed of the system would be as low as F/10, but in dealing with projection lenses of a high speed—the lens under discussion is constructed for the enormous speed F/2—we are confronted with the change of the corrections due to a different spacing. If a lens of this type is corrected for spherical aberration and coma for a certain separation, and we subject the system to a violent shortening, then we encounter an over-correction.

If, however, we lengthen the construction unreasonably, the system will suffer from the opposite defect, under-correction. In the first case the edgeray would intersect the axial ray in front of the focal plane; in the second case beyond the focal plane. The result would be poor definition and the construction would be a failure. For this reason alone a certain variable power system covered years ago by a U. S. Patent was never able to get a foothold in a projection room, for the aberrations were stronger than it could stand.

Fortunately, the problem presented by today's silent and sound film does not ask the designer to go to such extremes as described in the foregoing example. Although it is perhaps too early to say what the exact final change of magnification will be—here, by the way, some standardizer could make himself useful—it will be around 15 per cent. In such a case the aberrations are negligible. They are far below the tolerances the designer is using to judge the performance of a lens on the basis of the trigonometrical tracing of rays through the system.

We may resume the calculations started above with the assumption that the E. F. of the system has to be changed not more than 20 per cent. Using the above formulæ and substituting different Δ, we derive new focal lengths from the original 100 mm. lens: 105, 110, 115, and 120. Following are the results represented in table form using the notations:

Δ is the separation of the lenses.
E. F. is the equivalent focal length of the system.
B. F. is the back focal length of the system.
X is the required increase in the separation to derive a new E. F.
Y is the increase of E. F.
Z is the decrease of B. F.

Δ	E. F.	B. F.
100.57	100	49.16
109.93	105	45.65
118.45	110	44.13
126.22	115	41.62
133.35	120	39.11

X	Y	Z
0	0	0
9.36	5.0	—2.51
17.88	10.00	—5.03
25.65	15.00	—7.54
32.78	20.00	—10.05

Roughly speaking, it may be stated that Z is a linear function of Y, but that X must be expressed as a quadratic function of Y. Important as the exact figures are for the mechanic working out the movements of the sliding parts, for general information it may be remembered that an increase of the focal length of 10 mm. requires an increase of the separation of the two lenses by 20 mm., and that the whole system has to be brought 5 mm. closer to the film due to the shortening of the back focal length.

In order to bring out these relations more clearly the figures given above have been plotted on the following graph Fig. B. The same notation as in the table have been used. Therefore, the abscissæ representing x show the change in the separation and the ordinates of the first curve Y (the change in the E. F.), and of the second curve Z (the change in the B. F., which is always negative.)

The explanations given above will probably answer all the questions the projectionist may have. It will give him a clear insight into the methods the designer follows when a problem like the talkie and silent film is presented to him. It will also explain why such a system beyond a certain limit could not be used if the question of illumination cannot be ignored.

In conclusion, it is freely admitted that the problem of varying the size of an image by moving some lenses is as old as optical science. It has been used to some extent in other fields of applied optics, but it was always restricted to systems of a relatively low aperture.

The present system had to be worked out for a speed of F/2 and had to retain the critically sharp definition on both ends, and this feature alone distinguishes it optically from other constructions. It was a long way from the conception of the principle to a smooth working, foolproof sample, and the enthusiastic support from the best experts among projectionists was of inestimable value in producing what the trade was looking for:—a bifocal projection lens of high speed and critically sharp for both focal lengths.

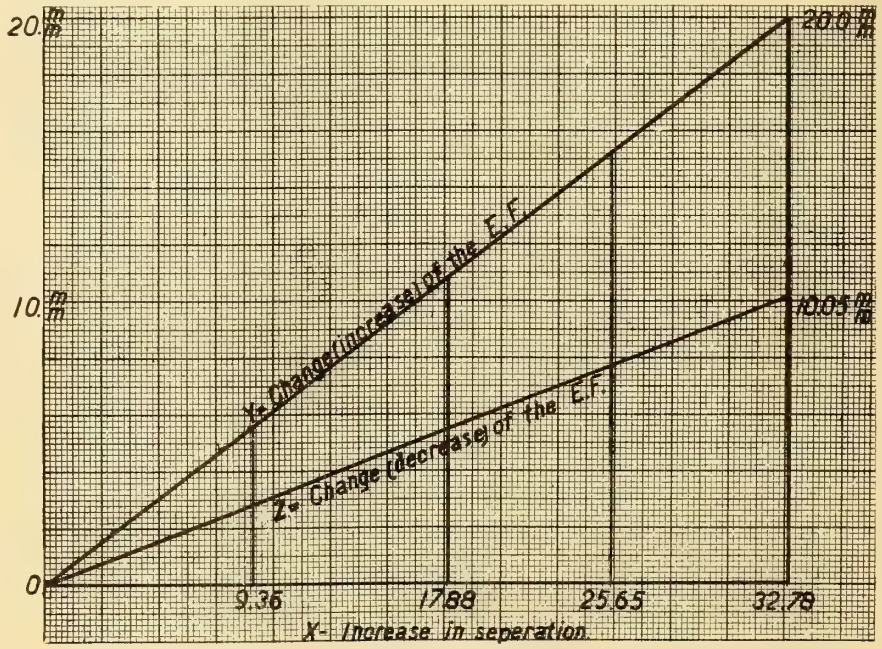


Figure B

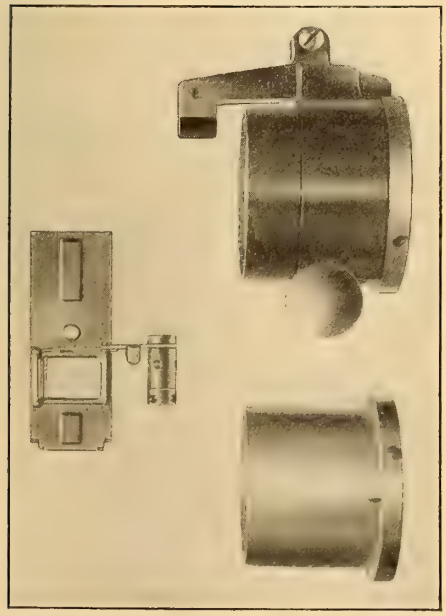
Motiograph Sound-Film Assembly

TO meet the almost universal practice, in theatres equipped for sound, of masking the aperture of the projector to standard proportion when projecting sound on film, the Enterprise Optical Mfg. Co. have developed a new type assembly which and efficiently accomplishes this much-desired result. The assembly which is adaptable to either the Model F or Model H Motiograph DeLuxe mechanisms is known as the Motiograph DeLuxe Sound Film Lens and Aperture Assembly, bearing the catalog number CS772C for the Model H and CS773C for the Model F Mechanism.

Lens Assembly

As pictured in the accompanying illustration, the assembly comprises a new type front lens barrel which is practically the same as the original front lens barrel as regularly supplied in the mechanism, except that it is bored out to a larger diameter. The new lens barrel replaces the original one in the mechanism and is easily installed without cutting, fitting or in any way altering the mechanism.

Supplied with the lens barrel are two lens holders. One of these (seen immediately below the lens barrel in the illustration), is bored out concentric with its outside diameter and designed to be permanently attached to the lens for silent pictures or sound-on-disc subjects. The other lens holder is identical except that it is bored out eccentric and is permanently attached to the shorter focus lens used to project a standard proportion picture from sound film. The amount of eccentricity in this holder has been carefully computed to exactly take care of the sideways displacement of the projected image.



Components of new Motiograph lens assembly

Both lens holders are provided with adjustments so that each lens may be exactly focussed and positioned for screen registration. When so adjusted, either lens may be inserted in the lens barrel and the projected image on the screen will be in exact position and exactly in focus. Once correctly set, there are no levers to move or other adjustments to make. The mere substitution of one lens for the other automatically takes care of the focus and screen registration. Both lens holders being provided with a locating pin fitting in a slot in the lens barrel, they cannot be placed in the wrong position.

Aperture Assembly

To the left in the illustration will be noticed the aperture plate and proportionate sound film mask. This aperture mask is unique in construction and also is easily installed in the projector mechanism without the necessity of drilling holes or in any other manner altering the mechanism.

The aperture plate is identical with the regular aperture plate originally supplied with the mechanism and which it replaces. Attached to it is the sound film mask constructed to operate on hinges and which is actuated by a finger lever. The mask is provided with a small "jack" to which the actuating lever is attached. This small jack providing a means of clamping itself within the rectangular opening in the rear lens barrel of the projector mechanism, makes the installation a very simple matter. The little swinging mask is identical in proportion to the silent film aperture and masks off a portion of the top and bottom of the picture as well as the sound track. By means of the finger lever it can be swung entirely out of the way or may be swung into position instantly when desired.

The assembly is supplied as a unit consisting of the new lens barrel, the two lens holders and the aperture plate and mask, together with the necessary fittings complete.

Projection Advisory Council Monthly Meeting

A REGULAR monthly meeting of the Projection Advisory Council was held on February 6th at the National Vaudeville Artists clubhouse, New York City. The meeting was well attended, the presence of many well-known figures in the projection world making it possible to conduct much interesting business. The following Council members and guests were present:

Members Present

G. S. Applegate, ERPI; F. W. Boettcher, Technical Supervisor of Sound, Loew's, Inc.; Paul Becker, Hugo Reisinger, Inc.; George Edwards, President, American Projection Society; James J. Finn, *Motion Picture Projectionist;* J. E. Francis, Manager Service Dept., RCA Photophone; Herbert Griffin, International Projector Corp.; E. Hoffman, Hoffman & Soons; A. G. Hulan, Supervisor Installation Div., RCA Photophone.

Also Lawrence Jones, Chief Projectionist, Loew's Valencia Theatre; E. T. Keyset, *Motion Pictures Today;* Charles E. Lewis, *Motion Picture News;* P. A. McGuire, International Projector Corp.; Jim Milligan, Associated Publications; M. D. O'Brien, Asst. Supervisor of Projection, Loew's, Inc.; A. L. Raven, Raven Screen Corp.; F. H. Richardson, *Exhibitors Herald-World.*

Also Harry Rubin, Director of Projection, Publix Theatres; J. E. Soons, Hoffman & Soons; Hirsch E. Stein, Publix Theatres; Benjamin Stern, Rialto Theatre; and Lewis M. Townsend, Publix Theatres.

RCA Photophone School

Following luncheon the meeting was called to order by P. A. McGuire who acted as master of ceremonies. Mr. McGuire called upon Mr. Francis to discuss the RCA Photophone Co.'s sound school for projectionists which was recently opened. Mr. Francis described in detail the methods employed at the school and cited some very interesting data on the results obtained. Mr. Francis stated that, in view of the results secured by this method of instruction, RCA Photophone was considering extending the school plan to various important centers.

George C. Edwards brought up the subject of sound observers in theatre auditoriums. Mr. Edwards gave as his opinion that projectionists in many theatres visited by him were seriously handicapped in securing proper volume control by the inability of the observer to formulate a definite method of handling individual presentations and specific portions of pictures. Mr. Edwards suggested the advisability of closer cooperation between observer and projectionist.

G. S. Applegate of Electrical Research Products spoke briefly of his company's aims and ideas with regard to an educational campaign.

The purposes of the Projection Advisory Council were outlined by H. E. Stein. F. H. Richardson brought up the question of projection nomenclature, and it was unanimously agreed that certain recommendations along this line should be forthcoming shortly from the Council. The discussion then turned to the work of the Council within the next few months. Following suggestions from several members, a committee to lay out the work to be done by the Council was formed. J. E. Francis, RCA Photophone, heads this committee and will report his findings at the next meeting of the membership.

New Advances in the Art

Combination Speaker

This is a speaker which is recommended for theatre work where a long, narrow house presents acoustical difficulties by reason of reverberations between the walls. It is rather directional and for that reason suits this type of house admirably.

It is actuated with the standard Operadio 10 inch electrodynamic cone and is capable of handling terrific power without blasting or distor-



The Operadio 10 unit

tion or mechanical breakdown. Unlike so many air-column speakers, the barrel like bass notes are not out of proportion to the highs, because the design permits direct highs to be radiated from one side of the cone itself, while the lows traverse the air column, being radiated from the other side of the cone. These direct highs plus the directional lows give this speaker excellent carrying characteristics.

Mounted on Platform

This speaker is sold mounted on a platform with ball-bearing casters, rubber-tired and is a high-class job in every respect. All wiring is in standard BX conduit and all terminals are brought out in junction boxes which will pass the Board of Underwriters' specifications.

This combination electrodynamic-air column is made in three sizes—small, medium and large.

New Power Supply

A new power supply has just been developed that eliminates the last battery necessary in talking motion picture theatre sound installations. Hitherto, all sound-on-film apparatus required a storage battery for the exciter-lamp as well as the head-amplifier tubes. This new power supply, designed and manufactured by the Radio Receptor Company of New York City, supplies the necessary current to the exciter-lamp and the head-amplifier tubes, as well as the B supply for the latter. There is absolutely no increase in hum level, above that present in the battery-operated appartus.

The special Powerizer voltage compensator is included in this new power supply, and regulates the line voltage so closely that between 100 and 130 volts variation on the line, there is a corresponding variation of not more than 13/100 of 1 per cent. This astonishing accuracy is due to the special design of this compensator, which is of the transformer leakage type.

Nearer the Truth

With the strides being made and in prospect, television should be pretty well perfected in 25 years, Elmer E. Bucher, executive vice president of RCA-Photophone, recently told the New York Co-operative Club. The combination of talkers, radio and television in the home is not far off despite the fact that television is not yet well developed, he said. A great number of engineers now are devoting time to television, Bucher declared.

Smoke Detector

Among the features of the General Electric display at the International Heating and Ventilating Exposition which has opened here is a smoke detector developed by General Electric which may be used for fire prevention. The device consists of a long glass tube. In one end is a light source and in the other a photoelectric or light sensitive tube. When the light intensity is dulled by smoke, the photoelectric tube responds, throwing a relay which starts an exhaust fan. The fan continues until the atmosphere is clear. The same device, it is claimed, may be utilized for fire detection, in which case the relay operates a buzzer or bell instead of the fan.

New Frequency Meter

A NEW frequency meter of the indicating type has been developed by Westinghouse. The design of this type *SY* frequency meter permits the production of instruments having a scale range of plus or minus 2 cycles for 60-cycle work, with operating torques at least equal to those used in corresponding voltmeters, and with a remarkable freedom from temperature or voltage error effects.

The earlier forms of frequency meters operating on the ratio principle used a divided electrical circuit, one branch being wound as non-inductively as possible, while the other side was made purposely as inductive as possible. As the frequency varied, the ratio between the currents in the divided circuit varied. and this allowed the instrument to be calibrated in terms of frequency.

The scale range of from 25 per cent below to 25 per cent above normal frequency was about the limit for such instruments making most



Fig. 1. Front view of meter

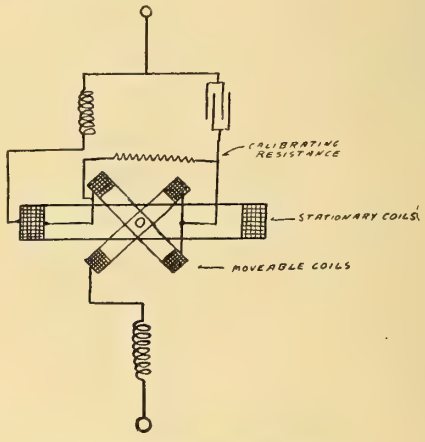


Fig. 2. Internal connections

of the scale range practically useless on modern systems, the frequency of which is maintained within close limits. The necessity for accurate indications within a narrow range of frequency only, led to the development of resonant circuits for the ratio type instruments, preferably using the dynamo-meter form of construction.

The new type *SY* instruments differ from the usual resonance type of ratio instruments in that a single resonant circuit of the parallel type is employed, which results in a very low volt-ampere burden. Figure 2 shows the internal connections. The circuit design is such that the change of resistance of the reactors and coils due to temperature variations produces no effect whatever. The indication depends only on the values of inductive and capacitative reactance. Thus the temperature effect is so small that it can hardly be meas-

ured. The use of a special type of condenser is partly responsible for this performance.

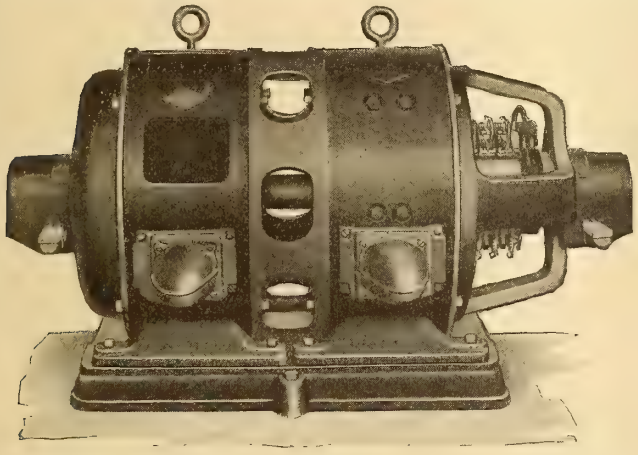
The ranges obtainable are from 54 to 66 cycles or from 58 to 62 cycles for use on 60-cycle systems. The narrow range scales are supplied for use on inter-connected systems and applied principally to power or lead dispatching.

Since such an instrument is responsive to changes of .01 cycles, frequency changes due to the load can be readily observed. The instrument is more accurate than the usual means available for calibrating. It therefore follows that where several instruments are required for load dispatching purposes at different points of a system, it is preferable to have all these instruments calibrated together, so as to eliminate the effects of individual observation errors in the original calibration.

Motor Generator Efficiency

QUALITY and refinement in motion picture projection is being developed to a remarkable degree and accepted standards today require every part of the equipment to be strictly high class and up to date. Motor generators and accessories for supplying and controlling direct current for the arcs come under this category and with wider films in sight greater capacity, which means larger generators, will be required.

The special nature of projection service requires that the generator be capable of carrying heavy overloads for short periods without distress such as heating, sparking at the commutator, and noisy operation, and the only way to meet this condition fully and satisfactorily is to design the machines specially for it. It is very necessary that motor generators for this service be quiet running and free from vibration, and in order to obtain these features the machines must be specially designed both electrically and mechanically with that end in view.



Two Bearing Set

Noiseless and Vibrationless

The supply of direct current for the arcs must be reliable and easily controlled, and the source of supply should be free from noise, vibration, and require the minimum of attention. *Quality also means safety.*

The Imperial Electric Company of Akron, Ohio, who have been building motors and generators of all types for more than 40 years, have paid special attention to quiet running motors because a large proportion of their product has been used in hotels, apartment houses and theatres where noise, hum and vibration cannot be tolerated. They were the first company manufacturing motors to give serious attention to this feature and architects have found that where they want a quiet running motor "Imperial" is the answer.

Constant Voltage Without Flicker

This feature and the overload capacity without distress which means long life and low maintenance cost makes Imperial motor generators extremely desirable and advantageous for motion picture service where high grade apparatus is looked for. Another feature of great importance to the Projectionist to which this company gives special attention is the compounding of the generator so as to maintain constant voltage at the arc without flicker when changing over.

One point which should be of special interest to the projectionist is the use of Ball Bearings in motor generators because their use means better operating conditions and less attention. The absence of oil prevents the collection of dust and dirt on the machine, lubrication being provided by grease cups which need only be filled up at infrequent intervals. Only those who have had experience with both the sleeve bearing with oil lubrication and ball bearings with grease cups can appreciate the difference. The additional cost for ball bearings is slight and their use is optional.

Self-Starting Feature

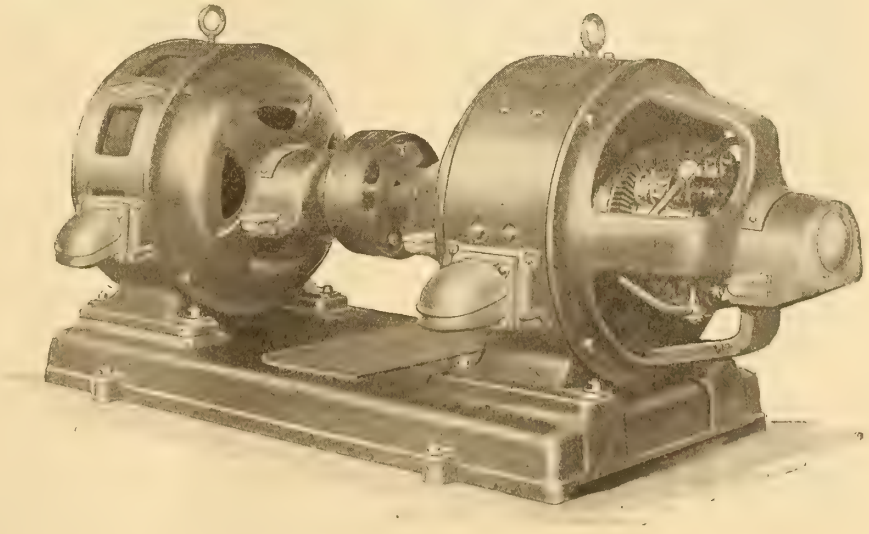
Imperial motor generator sets for motion picture service up to and including the 150-300 amp. size are generally furnished with type EN "self start" squirrel cage motors which can be started by connecting them directly across the line eliminating the use of expensive compensators which are in both first cost and maintenance.

When so started, the inrush current will be within the limits established by the N. E. L. A. which means that they comply with the rules of power companies who demand compensators for starting standard motors.

The Imperial line of motor generators includes two bearing sets for the smaller sizes which makes them very compact and take up very little space. Three and four bearing sets for the larger sizes—either sleeve or ball bearings can be furnished—see illustrations. Motors for any frequency and voltage can be furnished.

Conform to Standards

All Imperial motors and generators are built and tested in accordance with the recognized standard of the American Institute of Electrical Engineers and the National Electrical Manufacturers Association.

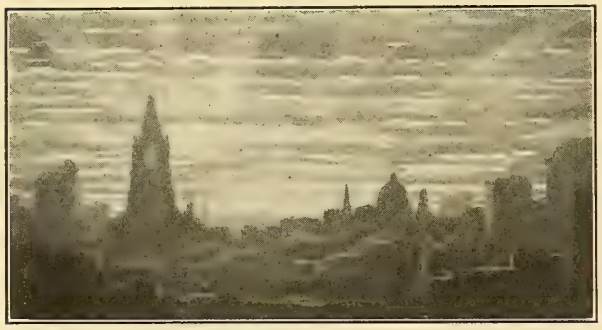


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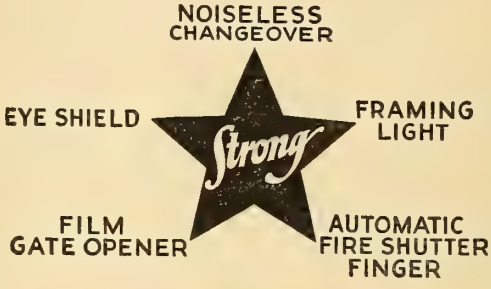
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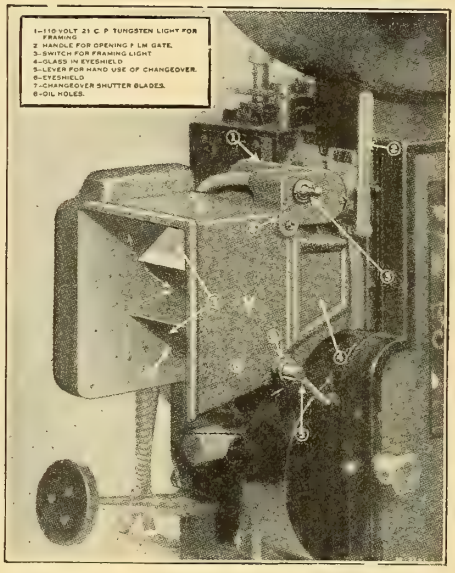
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Everyday Science

Simulating Sunlight

ARTIFICIAL sunlight for the lighting of homes, offices, factories and schools with all of the health benefits of midsummer sunlight and stripped of its dangers, is the prospect held forth by Dr. M. Luckiesh, Director of the lighting research laboratory of the National Lamp Works of the General Electric Company of Cleveland, in an address before the American Institute of Electrical Engineers. Dr. Luckiesh's talk was given before a joint session with the New York Section, Illuminating Engineering Society, as part of the program of the Mid-Winter Convention of the Institute.

He described a new lamp that had been developed as the result of research in the National Lamp Works Laboratory, and which combines the tungsten-filament with the mercury arc, simulating sunlight for lighting as well as health maintenance. The lamp can be operated through a wide range of angles, he said, and gives a light whiter than that which would be obtained from melted tungsten.

Benefits of Sunlight

Pointing to some of the major scientific facts which emphasize the value of sunlight, Dr. Luckiesh said that in many sections the death rate is highest in the season, or shortly thereafter, when sunlight is at its minimum; that there is evidence that fewer colds are experienced by persons systematically exposed to artificial sunlight than by those not exposed; that sunlight does cure and prevent rickets; that it is closely related to one or two vitamins, possibly all, and that the effect of a single exposure to powerful ultraviolet radiation for only a few minutes can be detected for two and sometimes three months afterward.

World's Fair Lighting

As a city of light, more dazzling than any invoked by Aladdin's lamp —buildings with walls apparently made of living colored light, perfectly mirrored in glittering lagoons—colored images painted on clouds a half mile in the sky—symphonies of all the hues of the spectrum, played from a gigantic color organ to the accompaniment of symphonic music and chimes—these are some of the glimpses of Chicago' 1933 World's Fair as seen through the eyes of Walter D'Arcy Ryan, director of the illuminating engineering laboratory of the General Electric Company, chairman of the fair committee on illumination.

"Artificial light has been foremost among the world's achievements of the last hundred years and will play a correspondingly important role at the exposition," says Mr. Ryan. Mr. Ryan was in charge of the illumination of the San Francisco, San Diego and Rio de Janeiro fairs and has declared that the 1933 exposition will mark a new epoch in illumination, introducing methods and materials now unknown outside the laboratory and never before seen in actual operation.

Additive Color Process

Processes of color photography all date back to the classic experiment of Clerk Maxwell before the Royal Institution in London, England, on May, 1861. On this occasion Maxwell demonstrated that any shade of colored light could be produced by combining various amounts of three primary colors, red, green, and blue-violet.

He used three separate lanterns and placed colored solutions before the lens of each. Ferric sulfocyanide was used for the red solution, cupric chloride for the green, and an ammoniacal solution of copper sulphate for the blue. When the light from all three lanterns was projected on the same spot on the screen, a white area appeared; when the red and green beams were superimposed, a yellow spot was obtained; with red and blue, a magenta spot, and with green and blue, a blue-green spot.

This is known as the *additive* method of color photography.

Recording Clock Keeps Tabs on Underground Trains

OLD methods of train dispatching having failed to give satisfactory results in the operation of London underground railways, due to increased traffic and extension of tubes to new sections, has led to the use of recording clocks and tapes which provide precise and accurate means of showing train movements and details of failures and detentions quickly to those responsible for remedying them.

Six Recording Clocks

Six recording clocks, one for each railway, have been installed in the entrance hall of the general offices of the railroad. The faces of these clocks consist of paper dials covering twenty-four hours, and are connected up electrically with a contact lever on the track. The passage of an individual train past a given point makes an electrical contact which causes a small inked hammer to strike the fringe of the dial. The dial rotates at the equivalent speed of the clock and as the hours go by, the fringe reveals a number of fine markings. These, if evenly spaced, show that the trains are running on schedule.

Train Record on Tape

As the dial makes a complete revolution in twenty-four hours, a whole day's record is thus obtained. If the service is not operating regularly and smoothly, gaps appear on the dial. While this affords no explanation of what has occurred, it does give intimation that something is "out" and provides an opportunity for the train dispatcher to investigate and regulate it. This is done by means of tape recording machines such as are used by newspaper offices, hotels, clubs, etc.

Water Power Cannot Supply Electric Needs

If every available electrical horsepower which could be generated by falling water were today developed, the total would be insufficient to meet the demands for electricity at the present time in the United States.

Much of the water power which can be economically developed has already been harnessed, but with 72 per cent of all water power in the United States located west of the Mississippi and 79 per cent of the demand east of the Mississippi, the dependence of the people of the United States upon electric power must be on steam-generated rather than on water-generated power, as it is uneconomical to transport electricity a distance much in excess of 250 miles.

Steam-Generated Juice

Then, again, the great increase in efficiency of steam-generated electricity, as compared with the comparatively stationary efficiency point of water-generated electricity, makes further development of much water power problematical.

A recent survey of electricity generated and used in the four great industrial states of Illinois, Indiana, Wisconsin and Michigan shows that while these four states consume nearly 17½ per cent of all the electricity used in the United States, only 10 per cent of the amount which they use is generated by water power.

This report also shows that electrical generating capacity in these states has increased 40 per cent during the past three years, and because of the large increase in transmission lines, this increased generating capacity is much more efficiently utilized.

205-Mile Welded Pipe

A 16-inch pipe line, 205 miles long, is now being laid from Jal, N. Mex., to El Paso, Texas, to transmit natural gas.

In the entire 205 miles there will be no bolted joints, the whole line being

made into one continuous piece by means of electric welding. The pipe is furnished in 30-foot sections, seven of which are welded together into one piece and then lowered into the trench where the welding to the previously completed length is done. To complete the job a total of 27 welding equipments are being used. They are hauled from place to place along the line by tractors or trucks.

P. E. Cell Television "Eye"

AN electric eye is the first element in the modern marvel of television. This eye sees the scene before it and converts it into electric currents which may be transmitted to great distances. The scientist calls this electric eye the "photoelectric cell."

This remarkable device contains a coating which is electrically sensitive to light. When a battery is connected, a current flows through the cell, the amount depending on how intense the light is upon the sensitive coating. So this current is an electrical representation of the light intensity and by transmitting this current by radio or wire, the same intensity of light can be reproduced at a great distance.

Divide Scene in Bits

By providing additional apparatus to divide up the scene or picture at the transmitting station and re-assemble it at the receiving point, television and telephotography are accomplished. A large photoelectric cell is used in television, and a small one in telephotography.

Telephotography, or the transmission of photographs, is now regularly carried on between eight cities in the United States. Television has been successfully demonstrated, but is still in the experimental stage. Much effort is being devoted to perfect it.

New Helium Supply

The accidental discovery in Southeastern Colorado of the richest known supply of helium, a rare non-inflammable element largely used in dirigibles, was described by Prof. F. F. Hintze, geologist at the University of Utah.

The helium content of the gas flowing from the discovery well, he said, amounts to 210,000 cubic feet a day, or about 7 per cent of the total volume of the gas produced by the well, as compared with the usual 2 per cent content in natural gas.

Aircraft and Storms

Prediction of thunderstorms five or six hours in advance, something expected to be very useful at airports, is believed to be possible by a new mathematical device called a tephigram, described by Mr. Clifford M. Alvord and Mr. Robert H. Smith of the Massachusetts Institute of Technology in a recent announcement of the United States Weather Bureau. A tephigram consists of a complicated set of curves drawn on cross-section paper to show the amount of energy available in the atmosphere for release as a thunderstorm, as wind, in warming the air after a rain or otherwise.

To use these tephigrams in forecasting thunderstorms, the first step is to send up a balloon, a kite or an airplane equipped with weather instruments, so that the temperature pressure and other conditions of the air at different heights can be recorded. These data are then plotted on the special cross-section sheets to form the tephigram.

The resulting figures belong, Mr. Alvord and Mr. Smith discover, to two general types, one of which indicates ordinary air circulation due to warm air rising from the ground while the other indicates a mixture of local and foreign air in the upper atmosphere. The morning of a summer day may show no visible signs, the investigators state, of thunderstorms which will develop later. But that morning's tephigram does show such signs, so that the thunderstorms may be predicted and aviators warned.

Humidity Endurance Limit

What are the limits of human endurance when the air is clogged with moisture under the blaze of a midsummer sun?

This is the question which Dr. W. J. McConnell of the Industrial Health Service of the Metropolitan Life Insurance Company tried to answer in laboratory experiments whose results he read at the annual meeting of the American Institute of Mining and Metallurgical Engineers at the Engineering Societies Building, No. 29 West 39th Street.

These tests have established, he stated, that the upper limit of the human body at rest, to compensate physiologically for atmospheric conditions, is reached at about 90 degrees Fahrenheit if the air is saturated with moisture and is still. Any increase in the velocity of the wind, he said, also increased the upper limit. When muscular work was done at the rate of 90,000 foot-pounds per hour the limit was reached at about 80 degrees.

These experiments were conducted in a two-compartment chamber insolated by cork board in order to maintain air conditions at the desired temperatures, humidity and velocity.

Pulse Rate Rises

The physiological efficiency of the body, Dr. McConnell pointed out, depends entirely on the relation between the rate of heat production and dissipation, as heat is being constantly generated within the body whose surface is, at the same time, uninterruptedly giving it off by radiation, convection and evaporation.

In abnormally high temperatures, he said, the more obvious disturbances take place in the circulatory system and flushing of the skin is observed, with profuse sweating and an increase in the pulse rate.

"The observations indicate," he continued, "that the pulse rate, rather than the rise in body temperature, apparently determines the discomfort experienced. When the pulse rate exceeded 135 pulsations a minute, the subjects complained of discomforts. The conditions became distressing and unbearable after the pulse rate exceeded 160 beats a minute. After the severity increased a feeling of 'floating in the air' was experienced, and it is probable that heatstroke would have supervened had the exposure been continued.

No Need for Oxygen

There was no apparent need for oxygen in these tests, according to Dr. McConnell, and it was found that the drinking of water during the exposures had little or no influence in retarding the physiological reactions. The maximum amount of work was performed during these tests in temperatures varying between 40 and 75 degrees.

The Huygens Discoveries

Busy with the affairs of the Prince of Orange, to whom he was secretary and counselor, the father of Christian Huygens probably had no suspicion that the boy's mathematical bent was heading him toward one of the great discoveries about light. Constantine Huygens did, however, observe that his son was brilliant. He had the lad tutored in music, geometry, and, at sixteen, put to studying law.

After improving the telescope by grinding better lenses, making important discoveries of heavenly bodies, and inventing the pendulum clock, Christian Huygens did other researches under the patronage of Louis XIV, having left Holland, where he was born in 1629, to live a number of years in France. He devised the spring escapement which made pocket watches possible.

Explained Refraction

At 52, back permanently in Holland, Huygens reached the peak of his genius in his discovery that light consisted of undulating waves. He explained the refraction or bending of light. Huygens conceived light to be a form of motion in whatever element it was passing through.

He showed that in entering or leaving one medium or substance for another, light underwent change in speed and direction. This he resolved into the law of refraction. He likewise showed that the angle by which light approaches a surface is equal to the angle at which it is reflected back from it. So Christian Huygens established the law of reflection.

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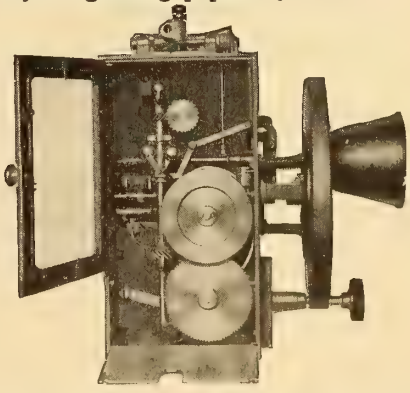
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The New Pentode Tube

DR. LEE DE FOREST*

THE pentode or five-element tube has come to the fore again, not so much materially as verbally. Radio improvements in the past six months have been neither radical nor spectacular. Perhaps it is with a view to creating a demand for something new in the radio line that certain tube manufacturers have taken the pentode out of the obscurity in which it has lain, dusted off the name-plate and are now putting it before the public. Some may call it a new tube. But such is not the case.

As far back as 1915 I developed several pentodes. In fact, in that year I applied for patents on several features of the tube. My interest in a multi-element tube goes back several years prior to that time. The patents were granted in 1916, 1917 and 1918. In those early days of hand-blown tubes, each lead of the pentode, except the filament, came out separately at the top of the tube, permitting of a great deal of experimentation. At that time in the history of radio the pentode might have come into popular demand.

Triode in Demand

But, chiefly because the three-element tube had been so much further developed. having been invented almost ten years before, and placed in the hands of the American Telephone and Telegraph Company, the commercial demands were for the three-element device. In the years following 1918, with the lifting of the broadcasting bans at the conclusion of the war, I turned my attention to the many other radio problems that sprang up like mushrooms. Recently the screen-grid, or four-element tube, came into existence, a great improvement on the former three-element tube. This may have served as an impetus to the revival of the pentode. If the screen-grid could so improve on the three-element tube, why should not the pentode likewise improve upon the screen-grid?

Unfortunately this logic will not completely fit the case in hand. My own early experiments with the pentode, while not devoid of good results, nevertheless failed to warrant the overthrow of the three-element tube in its favor. Of course, it must be remembered that in those early days many principles of the vacuum tube, now common property, were unknown.

The discovery of the many possibilities of the split-grid, used to such advantage in the three-element and screen-grid tubes, may apply equally well to the pentode. The present-day research in the pentode makes use of the tremendous fund of information gained since my early work in all branches of the vacuum tube.

The use of the pentode is at present confined largely to Europe, and especially England, where the battery-operated portable receiver is in great vogue. Moreover, the English broadcasting industry, being carried on the basis that the receiver of the entertainment should pay for it, works to the advantage of the pentode in that country. The tax which is levied on all radio receivers is based upon the number of tubes the set contains. Since the pentode obtains remarkable results using only one stage of amplification, thereby doing away with at least one other tube, its popularity is apparent as the great reducer of radio taxes.

Advantages of Pentode

I have on my desk in the office a six-element tube manufactured in Germany, an exceedingly delicate piece of workmanship and a beauty to behold. The pentode is neither new nor is it the last stage of multi-element tubes.

Designed as it is with the usual cathode and plate, between which are

*Courtesy of *The New York Times.*

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three grids, the pentode is meant primarily for use in the last audio stage in place of the usual 245 and 250 tubes. The use of the pentode eliminates one stage of radio frequency amplification. As perfected abroad, the sensitivity of the pentode is greater than that of our triode, resulting in higher amplification per stage. Due to the greater per stage amplification, it is possible to eliminate one stage of audio amplification working directly from the detector into a single power stage without danger of overloading either the detector or the radio frequency amplifier tubes.

The greatest advantage of the pentode lies in its use for battery-operated sets, where, with a limited plate voltage, greater undistorted output may be obtained than with the triode.

From the foregoing it might seem as though the pentode was destined to be the great forward step in radio for 1930. But I seriously doubt that it will so prove, at least in the United States. The pentode has many serious disadvantages. In the first place, the pentode gives no new results. Its advantage lies not in better results but rather in the same results obtained with fewer tubes. And though it might please the imagination to think so, it does not necessarily follow from the above statement that if the same thing can be accomplished with fewer tubes, better results may be accomplished with the same number of tubes. Nor is it clear that the cost of the complete receiver using pentodes would be less than the present sets using more triodes.

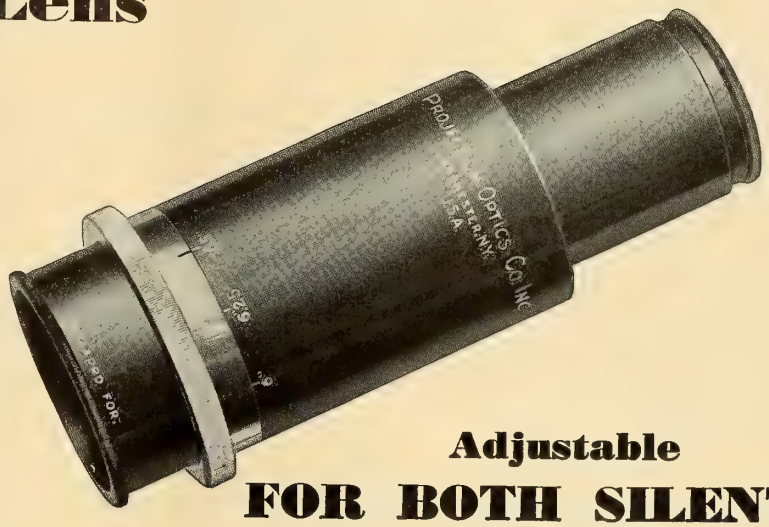
Uniform Production Difficult

As yet we have not considered the tube itself. Cutting down the number of tubes does not mean the cutting of tube costs. Due to the complexity of the pentode, and the extremely high vacuum which it demands, the pentode cannot as yet be manufactured with any degree of uniformity in quality and performance.

And whereas non-uniformity of triodes causes only a slight loss of quality in the operation of the receiver, a similar discrepancy in pentodes would cause the set to behave very poorly. Furthermore, let but one element burn out in the costly pentode and the entire tube must be thrown away, an uncalled for waste. It might be compared to an automobile so fabricated that when one tire is worn out the entire car would have to be thrown away. This is also true of the triode, but, being a less expensive tube, the waste is less.

Nor is it at all likely that the pentode will vie with the triode in popularity for use on the common volt AC current generally used. For this work, still other problems present themselves. At present the common practice is to use two 245 tubes in push-pull circuit, in order to reduce the AC hum and improve the tone

F/2.5 BI-FOCAL Super-Lite Projection Lens



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FOR BOTH SILENT AND SOUND FILM

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AS the name implies this new construction offers the projectionist everything he has been looking for; two focal lengths in one construction.

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These features have been made part of the F/2 BiFocal Super-Lite with no sacrifice of the well-known perfect qualities of the Super-Lite which has been used by the best projectionists for the last seven years.

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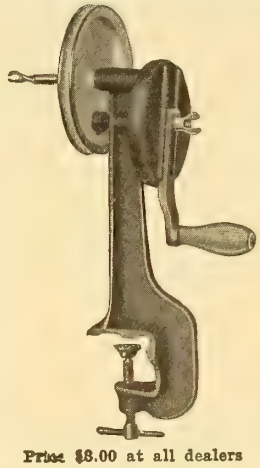
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quality. The greater complexity of the pentode circuits and the cost of the tubes make the practicability of using pentodes in push-pull an open question. Neither would it be advisable to use a single pentode for the same results now obtained by two triodes in push-pull.

Called "Sales Incentive"

I do not mean, by enumerating these problems and disadvantages of the pentode, to cast aspersions on the work of those who are trying to perfect the tube. The pentode has its uses. The increasing vogue for portable sets and for battery operated sets for the farmer may bring about a demand for the pentode. The revival for which I earnestly hope in the fields of amateur radio may create a demand for one-tube amateur transmitters.

But the widespread acceptance of the pentode for regulation receivers is most unlikely. If it does take place it will be, I believe, purely a temporary move on the part of set and tube manufacturers, for the purpose of instigating greater sales by use of a novel incentive to get the latest.

From the standpoint of an engineer, I doubt that the use of the pentode in regulation receivers will improve the reproduction quality. Development along the line of the pentode is not without its value. Great use will be made of the vast storehouse of information to which such experimentation will lead. And the day will come when some phases of radio will be greatly benefited by the use of the pentode. I doubt if a phase will be the wired home broadcast receiver. And I am sure that the day is not listed on this year's calendar.

"It May Be So—"

Dirigibles, such as the Graf Zeppelin, cannot fly without gas, and radio tubes cannot work with gas. As much care is devoted to getting the gas out of a tube as to keeping it in the Zeppelin. The vacuum in the modern radio tube is well nigh perfect, according to Walter Krahl, statistical expert and Chief Engineer of the Arcturus Radio Tube Company of Newark, N. J.

"Assuming that the residual gas in a good radio tube were all hydrogen," says Mr. Krahl, "it would require 167,000,000,000,000 tubes to supply enough gas to fill the gas bags on the Graf Zeppelin. A few years ago, before we perfected our evacuating systems, only half this number of tubes would have been required. Even today, alas! some tubes are fairly effective gas reservoirs.

"An idea of how many tubes are represented by the number 167,000,000,000,000," concludes Mr. Krahl, "will be more tangibly appreciated when it is mentioned that this represents the world's production for about three million years! Each year we leave about one cubic foot of gas divided among all the tubes on earth.

S. M. P. E. Standards Report

THE definition of Safety Film, as formulated by the committee prior to the last meeting and submitted to this Society at the New York meeting,* has been subjected to severe criticism from various sources. Many objections have been raised to the adoption of the definition in the form previously submitted. The committee has considered these objections and feels that some of them are valid and to meet them has formulated a new definition which it feels represents appreciable improvement. It will be recalled that the definition as formulated specified that any material having a burning time less than 15 seconds when tested under certain specified conditions should be called Safety Film, the burning time being determined by using a sample of the material of specified dimensions. The dimensions of the proposed sample are:

Length 36 inches, 914.4 mm.
Thickness 0.005 to 0.006 inch, 0.122 to 0.152 mm.
Width 0.63 to 1.378 in., 16 to 35 mm.

It has been brought to the attention of the committee that it is undesirable to base the definition of Safety Film on a burning time determined with a sample of these dimensions since motion picture materials are, or soon will be, in use varying over a much greater width range. For instance, film as narrow as 7 mm. has been proposed and several wider products (up to 70 mm.) have been made. Moreover, the thickness tolerances are not sufficiently great to include the possible materials which it may be desirable to use. For instance, some very thin materials, down to approximately 0.002 inch thick, have been produced, and it seems quite possible that it might be desirable to use materials appreciably thicker than the upper limit specified by the definition.

Meaning of Term

This point of view raises the entire question as to the fundamental intent and purpose of formulating a definition of Safety Film. It has been pointed out that the definition should relate to the combustion rate of the product as manufactured and distributed. This point, that the factor of importance is the rate at which a material burns regardless of its thickness or width, seems to the committee to be well taken and that it should be adopted in the formulation of the definition of the term *Safety Film.*

In order that the definition shall conform with this point of view it is necessary, therefore, to eliminate from the specifications of the sample, with which the burning rate is determined, statements relative to width and thickness and merely to state that the time of combustion for a sample of the material in question shall be less than some specified value.

Objection was also raised to the combustion time specified in the previous definition. Reference to the data relating to the burning time for various samples of news print shows in one case the burning time for a sample of standard length, namely, 36 inches, was as low as 10 seconds. It was pointed out that it seems illogical to formulate a definition of Safety Film which could be interpreted to indicate that some newsprint papers would fall in the unsafe category.

Of this the committee feels that the point is well taken and that the burning time should be specified as 10 seconds rather than 15 seconds, the value mentioned in the previous definition. This still leaves ample margin between the class of Safety Film and that of the commercial nitrate films

*May 6-9, 1929.

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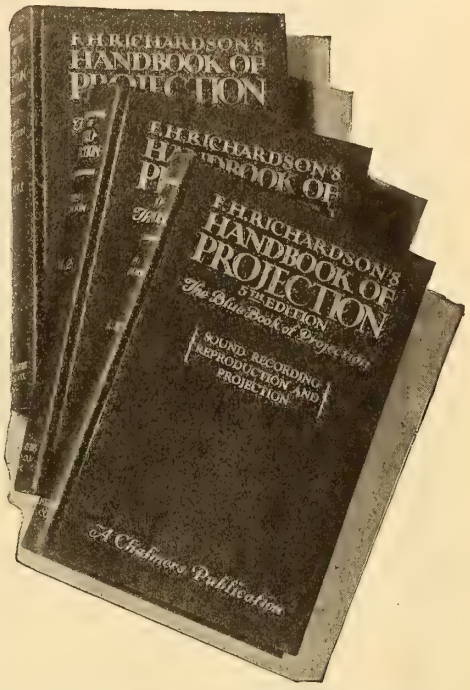
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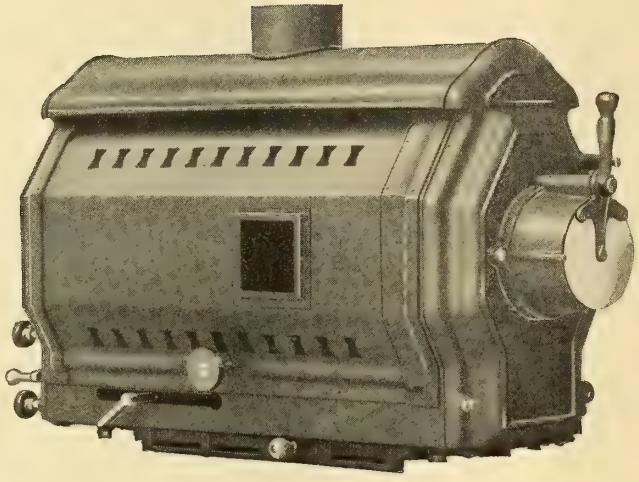
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which have burning times of 3 and 4 seconds.

It seemed desirable also to define somewhat more clearly the classes of materials to which this definition is intended to refer, limiting specifically its application to motion picture materials but at the same time making it include all types of materials that are used or may be used for this purpose. After careful consideration and lengthy discussion the committee therefore wishes to withdraw the definition submitted at the last meeting and to substitute the following:

> The term "Safety Film," as applied to motion picture materials, shall refer to materials which have a *burning time* greater than ten (10) seconds and which fall in the following classes: (a) support coated with emulsion, (b) any other material on which or in which an image can be produced, (c) the processed products of these materials, and (d) uncoated support which is or can be used for motion picture purposes in conjunction with the aforementioned classes of materials.
>
> The *burning time* is defined as the time in seconds required for the complete combustion of a sample of the material 36 inches long, the determination of burning time being carried out according to the procedure of the Underwriters' Laboratory. This definition was designed specifically to define Safety Film in terms of the burning rate of the commercial product of any thickness or width used in practice. The test of burning time therefore shall be made with a sample of the material in question having a thickness and width at which the particular material is used in practice.

Underwriters' Requirements

In making a determination of burning time the Underwriters' Laboratory prescribes that a strip of the material shall be suspended vertically by a small wire through a pinhole at one end of the test strip. A gas test flame ¾ inch long and ¼ inch in diameter is applied at the lower end of the suspended strip. The relative ease of ignition, height of flame, and time required for complete combustion are observed. Tests shall be made in a place protected so far as possible from drafts although no definite hoods or shields are used.

We wish to emphasize the fact that the definition is intended to refer specifically to a commercial product and to serve as a specification of the afety of this material as used in practice. It is realized that a given film base formula as used for making products which differ in thickness and width might in one case give rise to a product which may be classified as "safety" and in other cases the product would have to be classified as unsafe. We feel that this is desirable

and that the whole object to be achieved by the formulation of the definition is to promote safety in the utilization of motion picture film products.

Wide Film Developments

The committee has been watching with interest the developments leading to the introduction into the industry of film wider than the standard 35 mm. product. An attempt has been made to keep closely in touch with the developments and to obtain definite quantitative information as to the various proposals of the organizations interested in the wide product. This attempt has not been entirely successful, since it has been impossible in some cases to obtain precise information as to the dimensions of the film which it is proposed to use.

In some cases the committee has been supplied with dimension prints showing the proposed practice. The committee had hoped to be able to publish with this report dimensional drawings of the films being promoted by the various groups, but since these have not been obtained from all sources it does not seem advisable to publish any of them. However, in order that the Society may have general information as to the developments in this field, we have prepared a table in which is given approximate information as to the various proposals.

In some cases these dimensions have been scaled from samples of film and hence cannot be considered as representing precisely the dimensional characteristics. The various proposals which have come to the attention of the committee are as follows:

Processes In Work

Grandeur film, which has been developed by the William Fox organization, is 70 mm. wide and employs perforations of special dimensions as indicated in column B of the table.

The Paramount-Famous-Lasky Corporation has produced a film 56 mm. wide with standard perforations, the pull-down being 4 perforations as in present practice.

RCA Photophone, Inc., it is understood, is proposing to introduce the Spoor type using a film 63.5 mm. wide. While no definite information has been obtained as to the dimensional details of the final form which it is proposed to develop, the values in Column D give the dimensions taken from published reproductions of the Spoor "Natural Vision" picture.

One other proposal which, while it does not involve the use of wide film, but does give a wide picture in the theater should be mentioned. This is the proposal made by Mr. Ralph G. Fear to use the present camera and projector with an optical system attachment which rotates the image through 90° and in this manner gives a wide picture on 35 mm. film. The tentative dimensions of negative picture area available by employment of this idea are given in column A of the table.

It is interesting to note that practically all of these lead to pictures in which the ratio of width to height is 2 or more. This is in distinct contrast to the standard practice in which this

Table of Film Dimensions for Wider Pictures

	B	C	D	A
Width of film...	70 mm.	56 mm.	63.5 mm.	35 mm.
Picture width...	1.840″	1.62″	2.06″	1.813″
Picture height...	0.910″	0.742″	1.12″	0.800″
Perforation pitch	0.234″	0.187″	0.187″	0.187″
Pull down no. of perforations ..	4	4	6	10
Perforation dimension	0.130″×0.080″	Standard	Standard	Standard
Width of sound track	0.240″	0.125″		0.200″

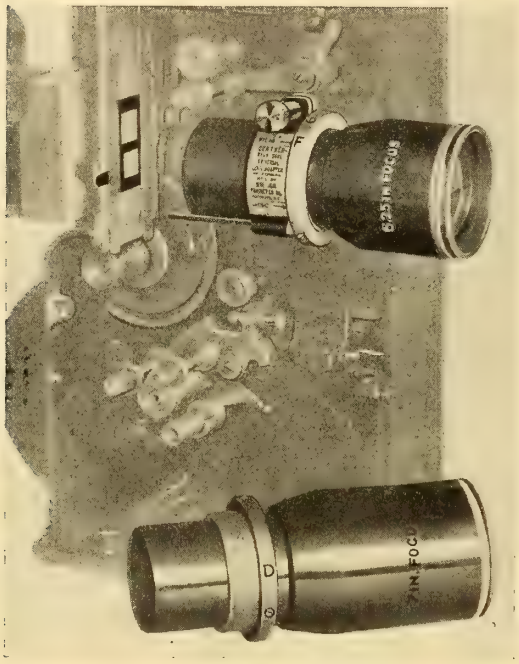
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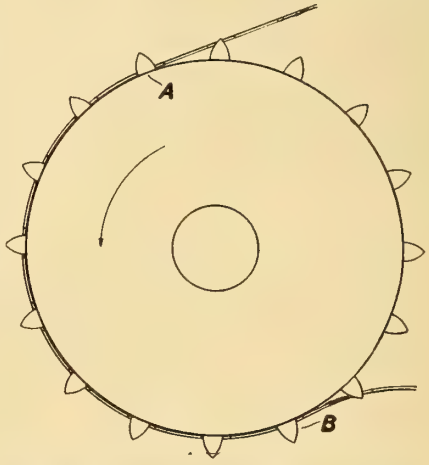
Projection Lenses for Motion Pictures

ratio (width to height) is 1.33, and in even greater contrast to the sound-on-film positive in which this ratio decreases to approximately 1.15.

Standardization Urged

There seems to be little doubt that there is a real need for a film wider than the present 35 mm. product. Even previous to the introduction of sound it was felt by many that the picture proportion available was not well adapted to certain types of productions, being too narrow relative to its height. The necessity of using a strip on the positive film for the sound record aggravated this condition, giving a picture area approaching much too closely the proportions of a square to be pleasing artistically and of practical utility from the standpoint of motion picture technic.

It seems obvious, however, that the introduction of more than one wide film is highly undesirable from the standpoint of the best interests of the motion picture industry as a whole. The cost of building new equipment, including cameras, processing machinery, projectors, etc., for any one new width will be great. The multiplication of widths will increase enormously the final cost to the industry of obtaining a more satisfactory picture width. The committee urges very strongly that these factors be considered and that every effort be made to reach an agreement on one standard wide film.



S.M.P.E. standard sprocket tooth contact

Summary

The following recommendations have been presented previously and have received the first approval of the Society. They are now presented with a recommendation for second and final approval.

1. Taking speed for standard 35 mm. sound pictures shall be 24 pictures per second.
2. Projection speed for standard 35 mm. sound pictures shall be 24 pictures per second.
3. The scanning slit (for combined sound and picture on 35 mm. film), shall be located at an average distance of 14.5 inches measured along

Realism and Resistance

By CHARLES PAUL*

ONLY one serious problem has blocked the path of perfect, steady, reproduction. As in so many industries, it has been the variable factor. A chain is said to be no stronger than its weakest link. In science the weak link is the variable factor. Automobiles, are built with the assumption that they are to be driven on fairly good roads. They are not designed to climb rocks or cross swamps. The type of use to which the car is put, however, remains the variable factor, over which the builder has no control.

A variable factor has also been discovered in sound reproduction. Like the automobile designer, the electrical equipment designer has taken for granted the road upon which the machine is to be used—namely, the current supply upon which the device is to be operated. Most electrical equipment, unless otherwise specified, is designed to operate on 110 volts alternating current. However, it has been discovered that the so-called 110 volts may and does vary anywhere between 90 and 130 volts, depending upon the locality, load upon the line, transformer equipment, time of day, and other factors beyond the control of the power company and the designer of the apparatus. Thus, the actual voltage applied to a sound amplifier may vary within wide limits, either momentarily, due to a sudden heavy load upon the line, or steadily as in the case of a voltage drop due to a long transmission line.

Current Fluctuation

Vacuum tubes operating below the specified voltage provide poor tone quality and weak volume. High line voltage, on the other hand, may result in a short but brilliant performance. The load being much greater than that for which the equipment was designed, resistors, transformers and vacuum tube filaments are subject to burn-outs.

With the realization that current fluctuation is the rule and not the exception came the necessity for providing some means by which a definite current supply of constant voltage could be maintained. In the development of a device to solve this problem resistance was called upon to play a most important part. The device was

*Clarostat Mfg. Co.

the film below the center of the picture gate.

4. The number of teeth in mesh with the film (commonly referred to as "teeth in contact"), shall be the number of teeth in the arc of contact of the film with the drum of the sprocket, the pulling face of one tooth being at the origin of the arc, as illustrated in the accompanying drawing.

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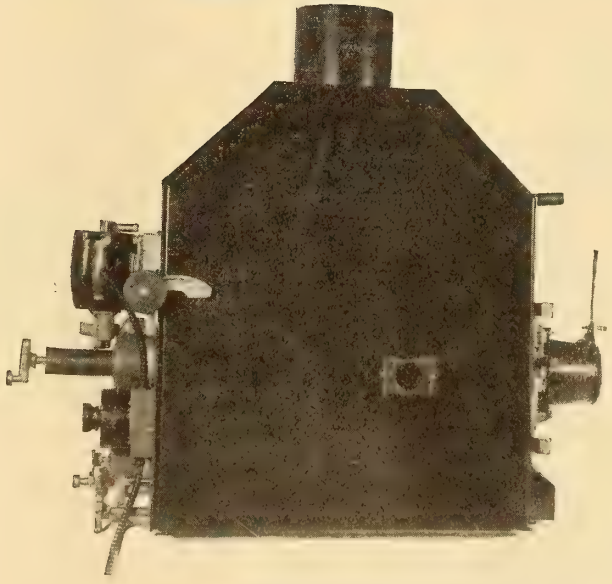
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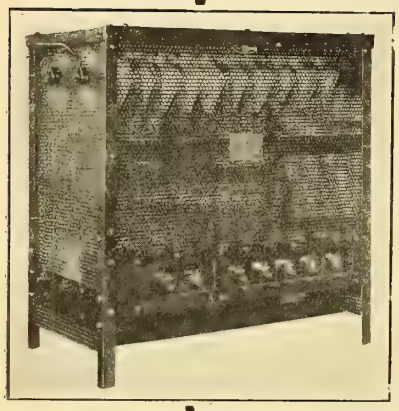


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called the line ballast, since it throws the weight one way or the other to compensate for any voltage fluctuation.

If the line voltage only dropped, it might be compensated for by the use of properly designed low-voltage transformers. Unfortunately, however, line voltages rise as frequently as they drop, making it impossible to employ low voltage transformers, since any increase above normal would seriously overload the tubes and result in disrupted service. The tapped transformer with a choice of two voltage ranges, adopted by some equipment manufacturers, was a half-way improvement. It was a relief measure, but by no means a cure, being unable to cope with line voltage fluctuations. Automatic and instantaneous regulation was necessary for complete satisfaction.

Clarostat Compensator

Rather than discuss further the qualifications of a voltage regulator, let us analyze the device that has been perfected and is in operation at the present time. The Clarostat line ballast operates on the automatic compensation principle of a series resistor with a high temperature coefficient, so wound and ventilated that a change in line voltage is instantaneously compensated for by a change in the resistance value of the ballast. A constant voltage is maintained on the transformer primary, even though the line voltage varies as much as 30 per cent., up or down. During this wide voltage fluctuation, the primary voltage, and consequently the secondary voltage of the transformer, varies less than the plus or minus 5 per cent. limit specified by vacuum tube manufacturers.

In this form of equipment the power transformer and the line ballast are matched, or designed to function together. If the average line voltage to be dealt with is 110 volts, the primary of the power transformer is designed for operation at 85 volts and the difference in voltage between this and the line is built up across the line ballast. Even though the line voltage changes within the limits of 100 and 130 volts, the transformer primary will never receive more than 89 volts nor less than 81, which figures are within the 5 per cent. leeway allowed by vacuum tube manufacturers. The sound reproduction will remain stable. Neither blasts nor whispers will detract from the quality of the performance.

Available Types

Several types of line ballast, all intended for the same purpose, but of different design are on the market. Some cover wide limits, but are sluggish and permit a slight shock on the tubes. Some are active but do not cover wide enough limits. And others advertised as "ballasts" are nothing more than small fixed resistors mounted on a plug-in base, prevent-

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ing overloading of the tubes but by no means compensating for weak voltage or acting as a ballast. The ballast is essentially a built-in proposition to be incorporated as standard equipment by the manufacturer of the apparatus. Just as we look for "ABC" bearings and "XYZ" axles in the purchase of a motor car, so it is well to make sure that the proposed amplifier carries a device on the order of the Clarostat line ballast.

The line ballast is but one of the many uses to which resistance has been put in sound work. Small wire-wound fixed resistors and heavy-duty variable controls all have duties of their own to perform in the sound outfit. Incorrect grid bias, incorrect plate voltages, incorrect input and output voltages, incorrect volume control, these and many other allies of the demon, distortion, have been corrected in the perfectly constructed amplifier.

A Fine Picture—A Fine Tribute

It is not very often that any company engaged in the technical end of the motion picture business exerts itself to pay tribute to the combination of technical talent which combines to make a good motion picture—much less to express this commendation through the medium of paid advertising. Very seldom indeed is the projectionist tendered a tribute for his contribution to the success of any picture. For this reason the advertisement of the International Projector Corp. which appears on page 51 of this issue is noteworthy.

This advertisement lists practically everyone who did their bit for the success of the picture. Producer, director, stars, featured players, cameraman, etc., are listed, as is the personnel of the exhibiting company, and the names of the entire projection staff of the theatre where the picture had its premiere. This compilation of data on the picture represents no little work, and P. A. McGuire of the International Projector Corp. who is responsible for the advertisement, is deserving of a vote of thanks from the technical section of the industry.—J. J. F.

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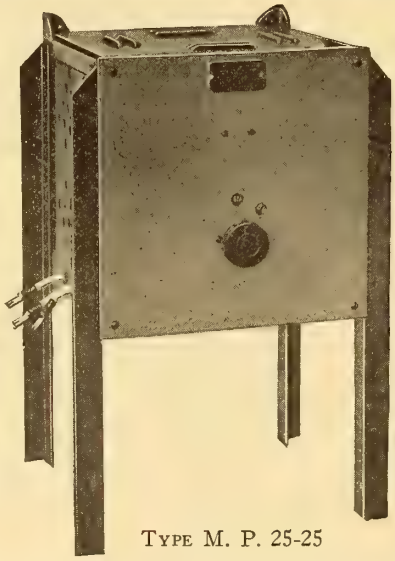
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PREMIERE ASTOR THEATRE, NEW YORK, JANUARY 28, 1930

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Metro Goldwyn-Mayer presents
LAWRENCE TIBBETT
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"THE ROGUE SONG"
with
CATHERINE DALE OWEN
STAN LAUREL, OLIVER HARDY
A LIONEL BARRYMORE PRODUCTION
ASTOR THEATRE, NEW YORK
JANUARY 28, 1930

The Cast

Yegor	LAWRENCE TIBBETT
Princess Vera	Catherine Dale Owen
Princess Alexandra	Nance O'Neil
Countess Tatiana	Judith Vosselli
Prince Serge	Ullrich Haupt
Yegor's Mother	Elsa Alsen
Nadja	Florence Lake
Ossman	Lionel Belmore
Hassan	Wallace MacDonald
Petrovna	Kate Price
Frolov	H. A. Morgan
Count Peter	Burr MacIntosh
Azamat	James Bradbury, Jr.
Ali-Bek	Stan Laurel
Murza-Bek	Oliver Hardy

Based upon the operetta "Gypsy Love" by Franz Lehar
Dr. A. M. Willner, Robert Bodansky
Story by Frances Marion and John Colton. Suggested by Wells Root
Music by Franz Lehar and Herbert Stothart
Lyrics by Clifford Grey
A Metro-Golduyn-Mayer All-Talking Picture
Photographed by Technicolor Process
Directed by Lionel Barrymore

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of the press hails
THE VOICE
of the screen

"When Tibbett's voice swells from the screen, one forgets that the singer himself is not on the stage. Never before have a singer's efforts on the screen been applauded so genuinely. To be able to listen to Mr. Tibbett sing is ample reward for sitting in one's seat." —HALL, Times

"Musical romance such as it never has been presented upon the screen was brought to the Astor Theatre last night by Lawrence Tibbett. Thus the talking screen may be said to have achieved its real expression for the first time. 'The Rogue Song' may be put down unequivocally as one of the great achievements of the cinema. The thought occurred as we filed out of the Astor last night that we had just witnessed a revolution of sorts. The picture has everything in it which human ingenuity could give to it. Get ready to make a trip to the Astor." —GERARD, Eve. World

"While the Astor Theatre rocked with the continued applause of an enthusiastic audience the superb voice and tremendous personality of Lawrence Tibbett reached the singing screen. There is not the slightest doubt that the Metropolitan star as the general factor brought to maximum pictures across the advent of sound. A superb production, most creditable to the entire industry and a fine bright feather in the cap of Metro-Goldwyn-Mayer. Many an audience will echo the applause of that Amsterdam last night's premiere." —CREWE, American

"Surely the best of the operettas in many years. Tibbett is remarkable in his acting in his songs, he is superb, and has much been more or astonishingly successful." —COHEN, Sun

"An expert pioneer step in the exploration of the new cinema's potentialities. Finest voice it has yet captured." —WATTS, Herald Tribune

"The advance reports in regard to 'The Rogue Song' were entirely justified. The new offering easily becomes one of the pictures that must be seen." —BOOKMEL, Telegram

"Magnificent. The most pretentious of the musical movies. 'The Rogue Song' is new, different, immense." —JOHANSEN, Mirror

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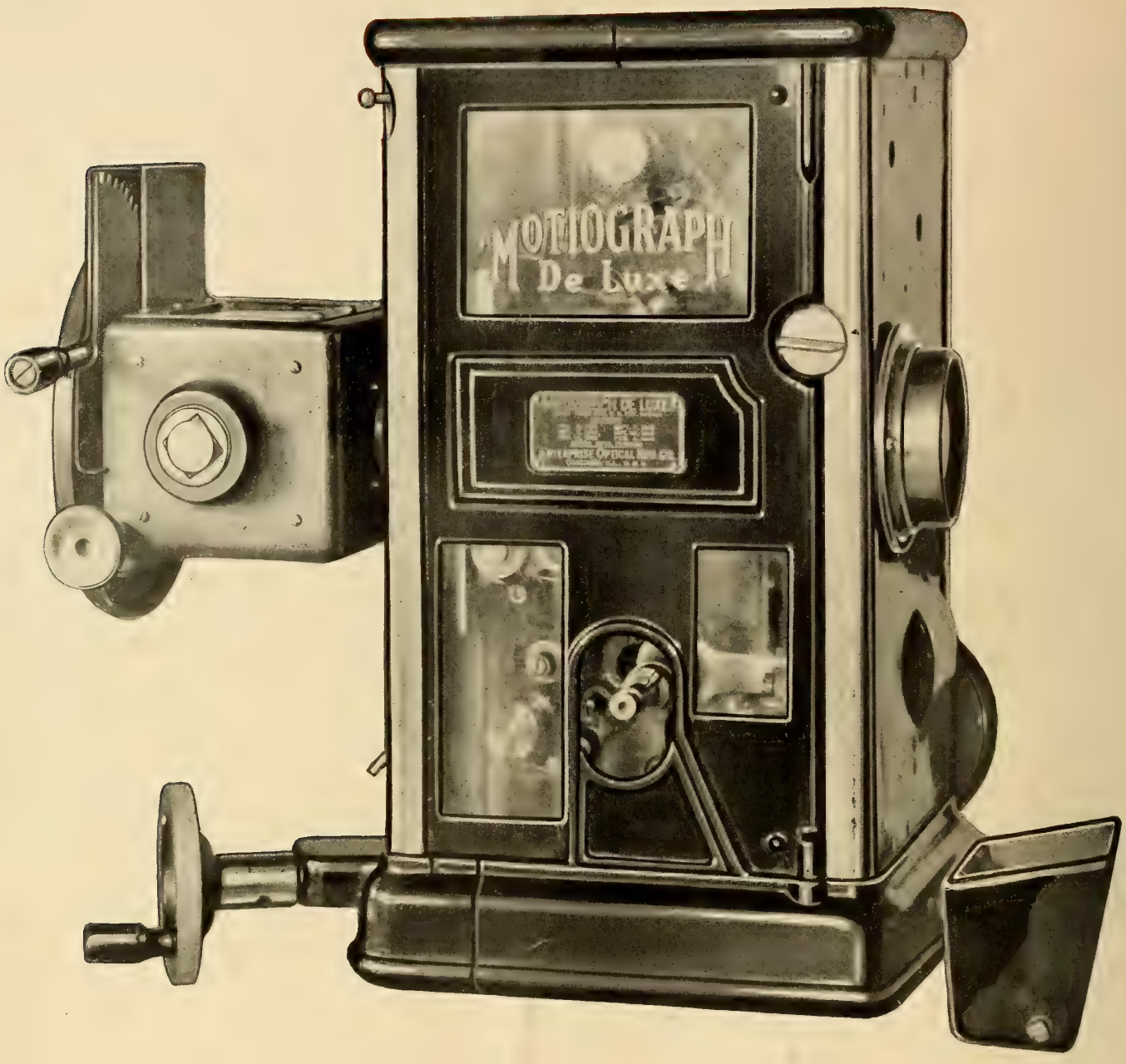
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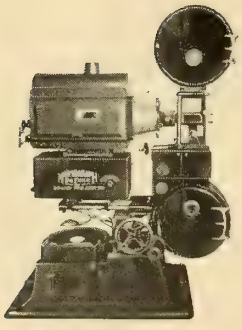
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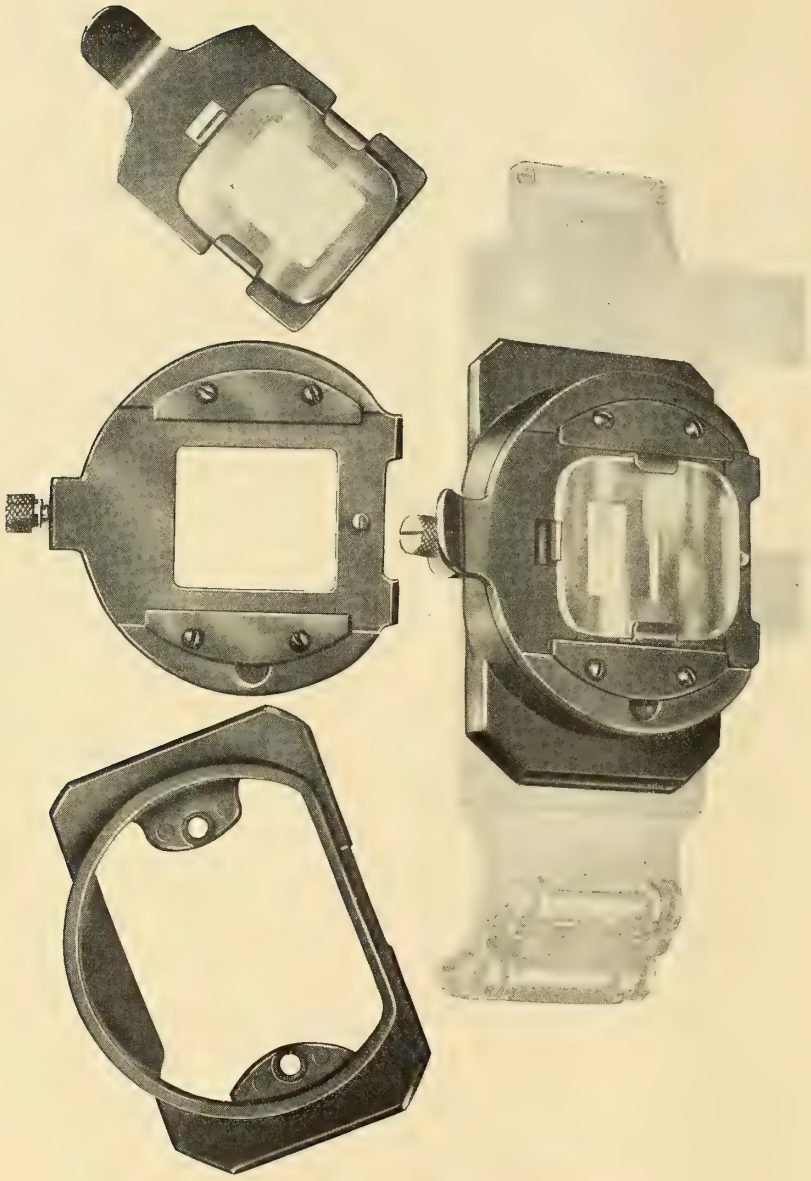
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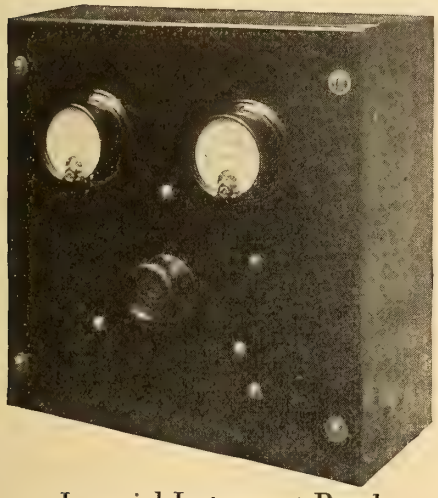
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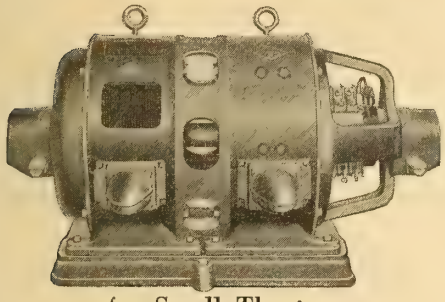
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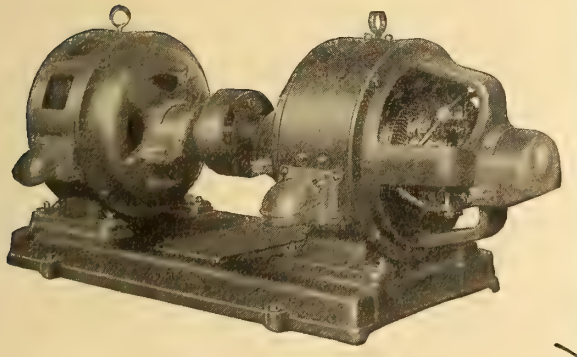
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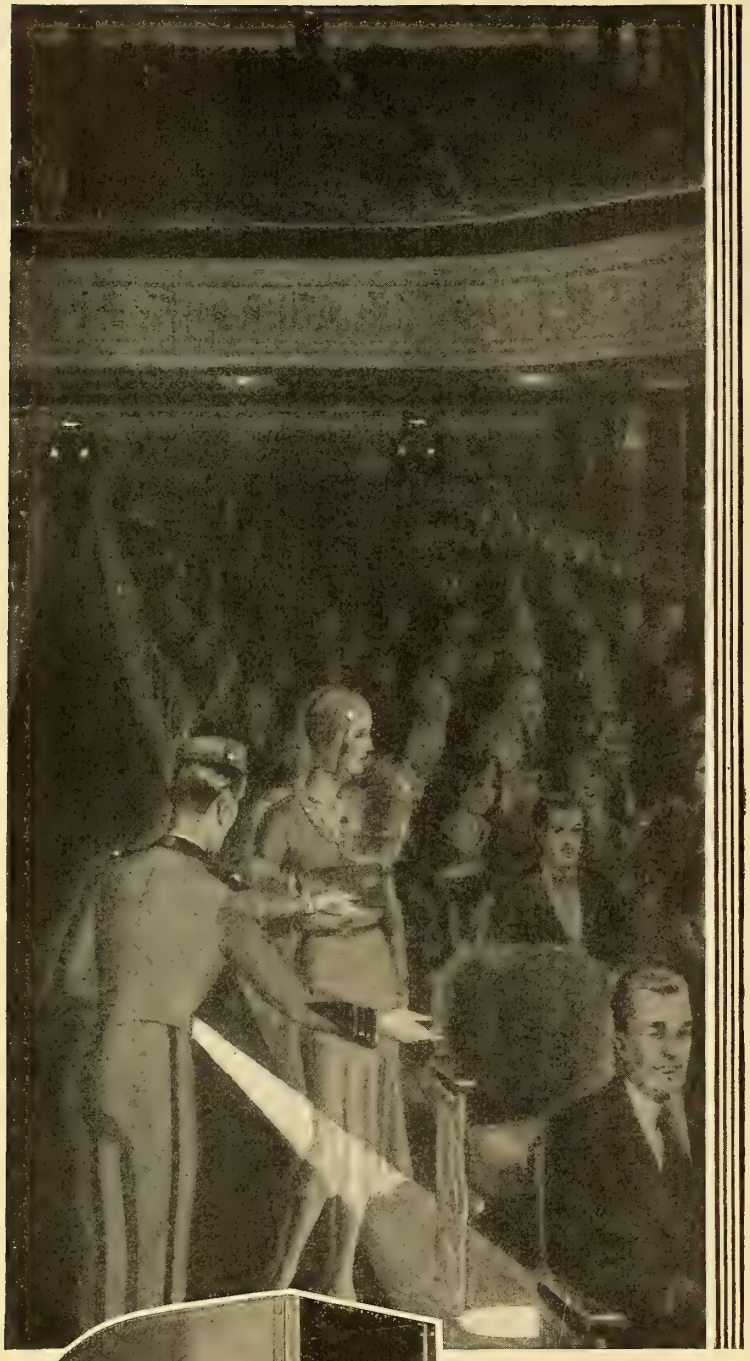
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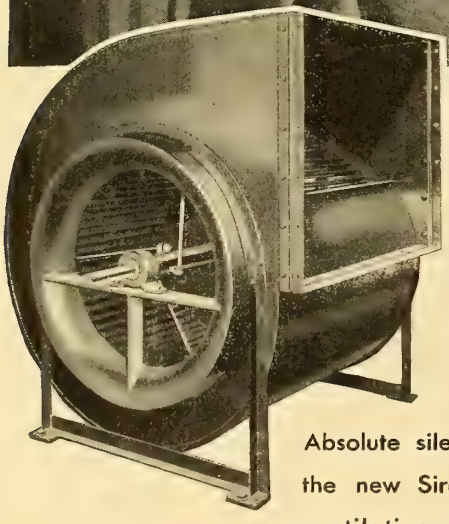
April, 1930
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(*Continued on page* 12)



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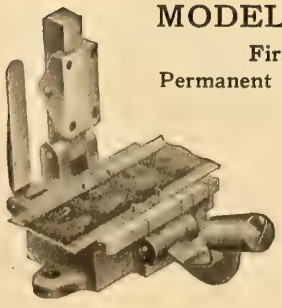
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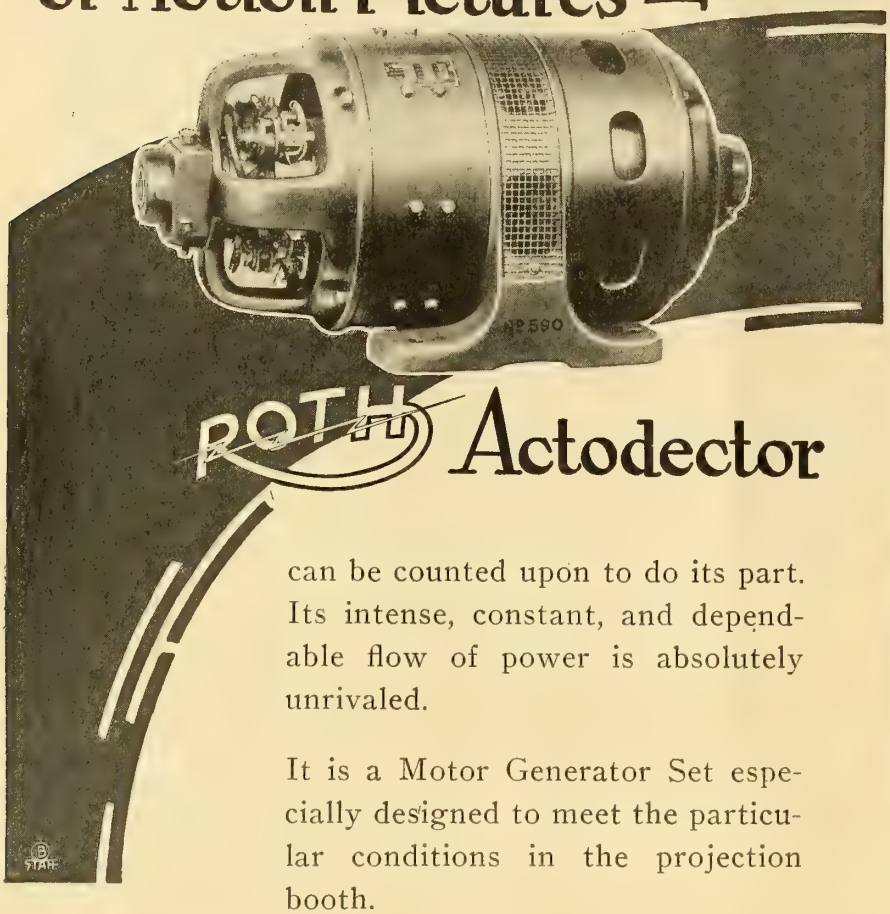
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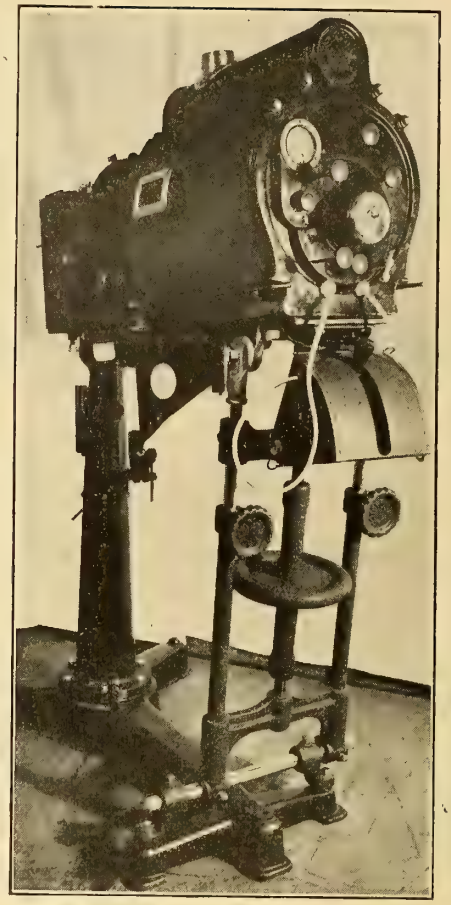
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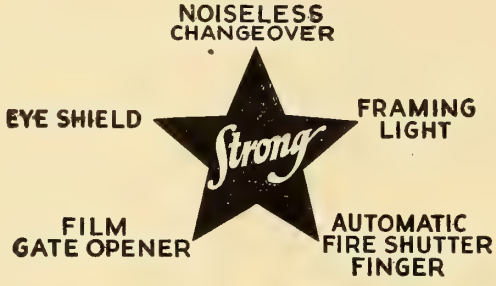
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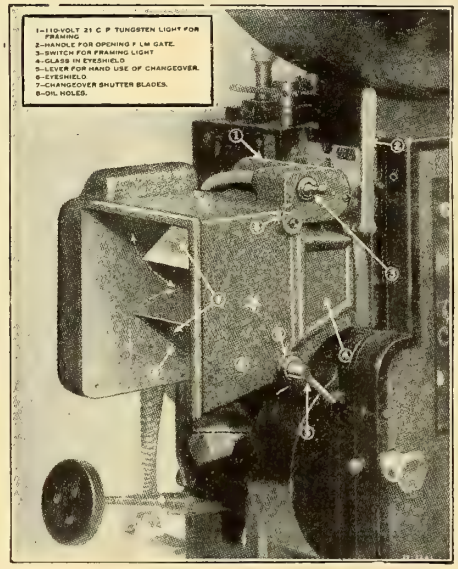
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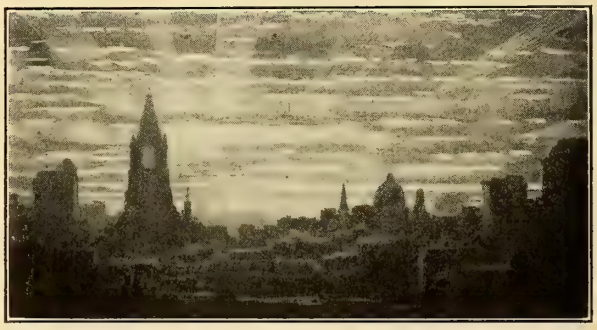
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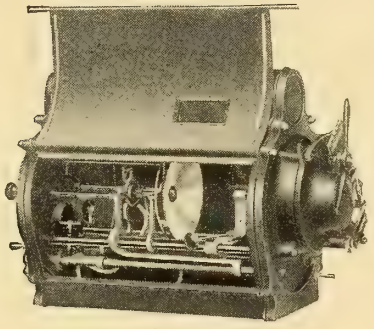
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Silencing Studio Arcs

(*Continued from page* 5)

similar to that used in the camera silencing investigation recently conducted under the auspices of the Academy.

Three different methods are now in use for silencing arc lights in the studios, it was revealed in a preliminary survey. Amounts of arc lighting now in use and types of filter favored were indicated as follows:

Amount of Arc Lighting in Use

Per cent. Arcs	Studios
None	Warner Brothers and First National.
5 to 10%	M-G-M, Educational, Columbia, Tiffany, Tec-Art, Universal, and Hal Roach.
25 to 50%	RKO, Pathe, Paramount, Metropolitan, United Artists, Sennett.
90 to 100%	Fox Studios.

Types of Filters Used on Arcs

None—Hal Roach. *Studios.*

Individual choke coils for each lamp—RKO, Paramount, Universal, M-G-M, Educational, Columbia, Tiffany, United Artists, and Fox. *Studios.*

Chokes to handle a group of lamps—Pathe, Tec-Art, and Educational. *Studios.*

Filter at generator—Metropolitan and Fox. *Studios.*

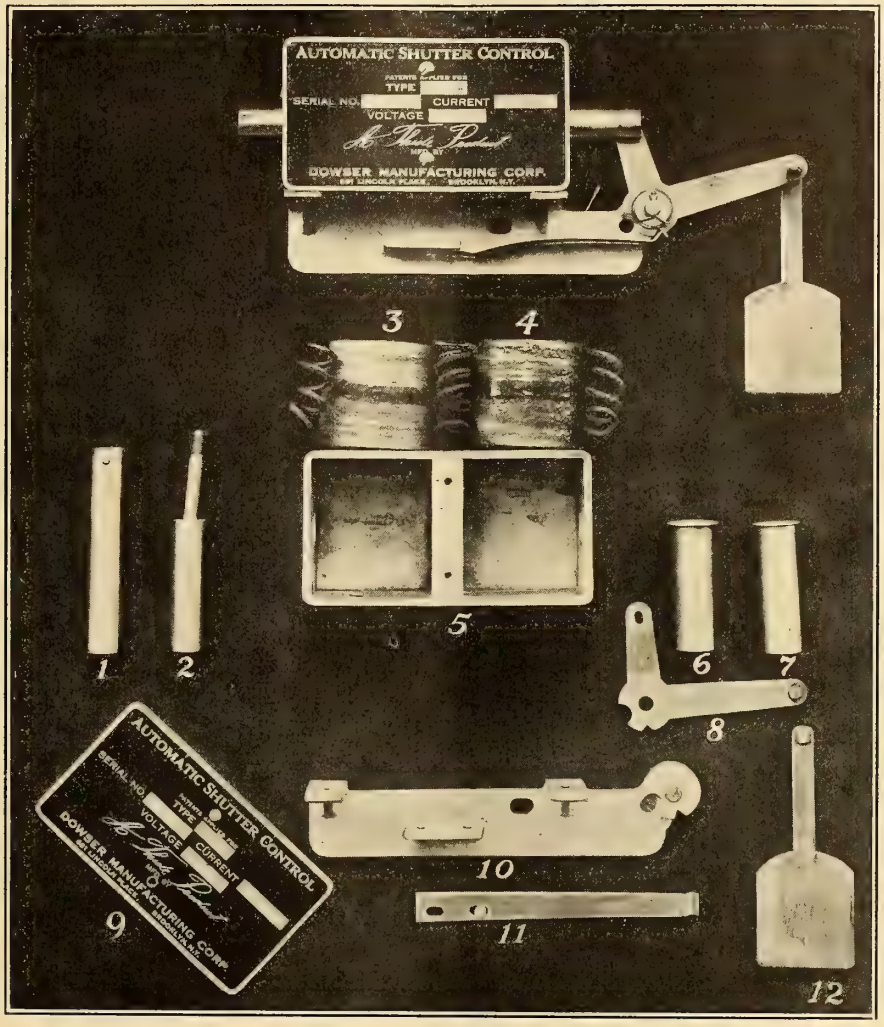
Special apparatus has been designed so that the tests of generators can be made while the studios are in production.

Improved Sound Reproduction

M. C. Batsel, chief engineer of RCA Photophone, Inc., is now in Los Angeles for a series of conferences with RCA Photophone recording licensees. It will be Mr. Batsel's purpose to discuss existing sound recording conditions and certain improvements and innovations that at present are under consideration.

"Sound recording and reproduction have improved greatly during the past year," said Mr. Batsel in discussing his forthcoming visit to the center of sound production activities. "We now have reached the point where we have assurance that a well-recorded sound picture will be faithfully reproduced if the film or disc upon which the sound is recorded is projected by projection equipment of a high standard. While rapid strides have been made since sound invaded the screen, constant improvement has been noted and I look forward to the not-far-distant day when sound pictures will play a most important part in the fields of industry and education. The world's foremost electrical engineers are engaged in the development of improvement in sound recording and sound reproduction.

The Changeover Adopted as Standard Equipment



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2. Armature (Male)
3. Closing coil
4. Opening coil
5. Housing
6. Armature Sleeve (Female)
7. Armature Sleeve (Male)
8. Bell-crank
9. Nameplate
10. Mounting bracket
11. Shutter spring
12. Shutter

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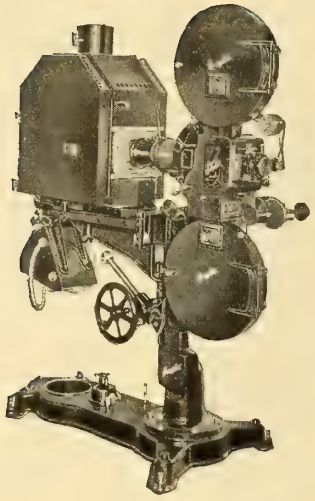
The changeover is positioned so that the cut-off shutter operates at the smallest cross-sectional area of the light beam, which makes for increased efficiency in that it permits of a smaller shutter operating through a smaller space and enabling the most rapid changeover with the minimum current consumption.

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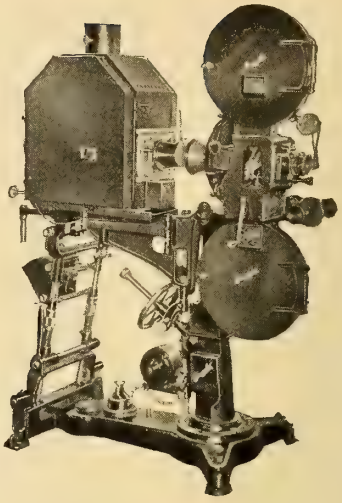


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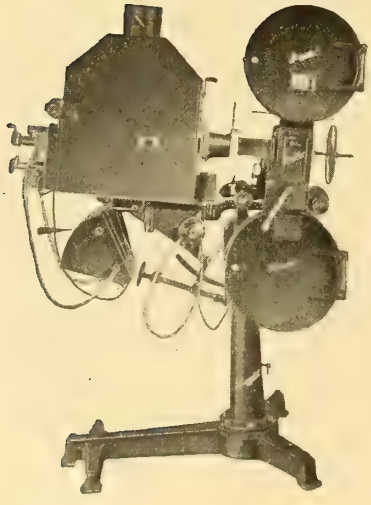
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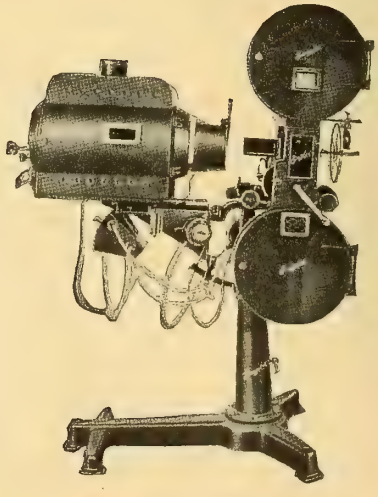
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Fundamentals of Amplification

By EDGAR MESSING

II

IN the last article of this series* we spoke about electrons and explained how all substances are ultimately composed of these electric charges; and from this basis we proceeded to show what a battery is, what an electric current is, and explained why some substances are not as good conductors of electricity as others. These poor conductors, we said, possessed *resistance*, which is the first of our electric variables. It will be seen that the whole science of electricity in general, and amplification in particular, consists of juggling four individual electric variables to obtain certain specified conditions. We learn first what these units can do, and then, as we are designing electrical machinery, we synthesize them; if we are analyzing a circuit, we study their individual effects.

Let us make a mental note of our four variables, which are: *resistance*, *capacitance*, *inductance*, and *voltage*. The first three of these variables are fastened deeply into voltage and exert enough influence upon it to make it do as they direct. The next step, then, is to explain just what these first three units are and show how they control voltage.

This explanation may appear to some to be rather a long road around to the point where we shall discuss the vacuum tube proper, yet an understanding of these fundamental matters is absolutely essential to a clear and comprehensive idea of the subject. The basis of any given phenomenon must first be clearly understood before one may logically proceed to a consideration of cause and effect, why and wherefore.

Electronic Action

Previously a battery was defined as a source of potential having the effect of many electrons at one terminal and a lack of electrons at the other terminal. These terminals we shall term *negative* and *positive*, respectively. This difference is due to chemical action within the battery and represents a difference of electrical potential or voltage. The greater the lack of electrons at one terminal and the more electrons at the other terminal the higher the potential difference across the battery, or the greater the voltage across it. If the battery is connected to some conducting substance, such as a copper bar, the electrons begin to stream from the negative terminal of the battery into the copper bar. The more electrons present at the terminals—or, in other words, the higher the voltage—the greater the number of moving electrons. These electrons begin to fight their way toward the other end of the bar in the direction of the terminal where electrons are lacking. The greater the number of electrons that stream off into the bar, the more there are that will make their way through the bar to reach the other terminal.

These electrons will progress slowly through the bar, as shown in Figure 1, to the other terminal, go through the battery and start over again.

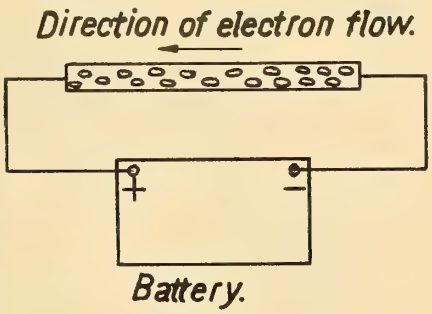


Figure 1

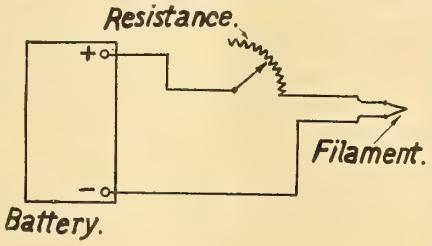


Figure 2

This procession constitutes an electric current.

Units of Measurement

As previously pointed out, some substances offer more resistance than others to these electrons. From these statements we can tell what governs the number of electrons passing through the bar or the electric current. One consideration was the number of electrons at the battery, and the other was the resistance offered by the copper bar. There is, then, a direct relationship between voltage, current, and resistance, and if we know any two of these factors, we can find the third. The unit of resistance and the unit of current have been defined thus: a certain amount of electronic charge passing in one second has been called one unit of current; and twice as much has been called two units, etc. In honor of three great physicists these units have been named *volt*, *ampere*, and *ohm*, and they are so related that when a potential of one *volt* is put across a resistance of one *ohm*, one *ampere* will flow.

This relation is invariable: if the battery of Figure 1 has a value of one volt, and the resistance of the circuit is one-half ohm, then two amperes flow. If the resistance should be one-quarter ohm, then four amperes of current pass. Similarly, if the current were three amperes, the resistance must be one-third ohm. We see from this that the voltage called E and signifying electro-motive force, equals the resistance R times the current I, or:

$$E = I \times R$$

If we divide both sides of this equation by R, (and we may do this without changing the value of the relation, because things that are equal if divided by equals are still equal), we get:

$$\frac{E}{R} = I \times \frac{R}{R} = I \times 1 = I$$

or, the current in a circuit equals the voltage across it divided by the resistance. Or, we might divide both sides of the equation by I and get:

$$\frac{E}{I} = \frac{I}{I} \times R = R$$

or, the resistance of a circuit equals the voltage across it divided by the current through it.

To use a practical example we may consider a 100-watt lamp as ordinarily used. The usual voltage across such a lamp is 110 volts and the current through it is 10/11 ampere. To find the resistance of the lamp we use:—

$$R = \frac{E}{I}$$

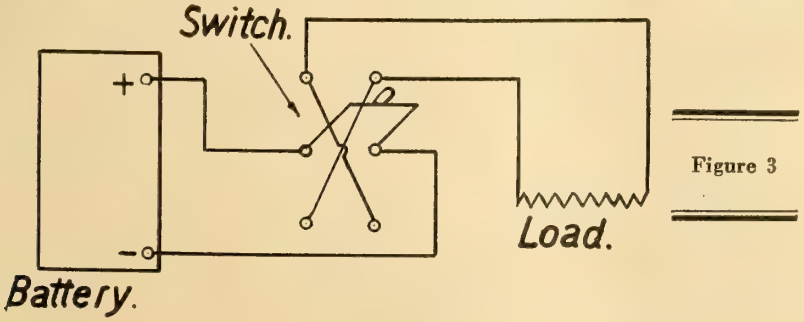


Figure 3

* Vacuum Tube Theory and Practice, pp. 18-19, December, 1929, issue.

from which:—

$$R = \frac{110}{\frac{10}{11}} = 110 \times \frac{11}{10} = 121 \text{ ohms}$$

It will be seen that the effect of resistance is to limit the current. We apply this principle when we turn a rheostat controlling the current to the filament of a vacuum tube. The rheostat consists of an arm moving over a resistance so as to introduce more or less resistance material into a circuit, as in Figure 2. The preceding discussion includes the most elementary part of electrical theory—a series circuit consisting of resistance and a source of constant voltage.

Alternating Current

The battery is a source of constant voltage. It forces the electrons to travel around the circuit in one direction. But if we should connect the battery to the circuit through a reversing switch (Fig. 3), and throw the switch first to one direction and then to the second, we would cause a reversal of the electronic flow so that there would no longer be a steady progressive movement. If we were to throw the switch handle up and back 60 times in a second we should be duplicating the reversals in the usual alternating current power line. This reversal of electronic flow we call an *alternating current*. The alternations in power circuits are of the nature of 120 per second, while in radio circuits they may be any number from 30 to several million per second.

Usually these alternations are expressed in cycles, where a cycle is a complete reversal including one positive and one negative change. The number of cycles per second is known as the *frequency*: thus a frequency of 60 cycles means that there are 60 complete reversals per second; or that there are 60 positive and 60 negative polarities presented to the circuit in one second. Other characteristics of alternating currents will be cited later, for it is with these currents that we are mainly concerned.

Magnetic Fields

Almost everyone is familiar with the action of a magnet and knows how it attracts and holds to itself bits of metal. The space about a magnet is said to contain the *field* of the magnet. Lines are used to represent the field and these lines are directed from the north pole of the magnet toward the south. An electric current through a conductor has around it the same sort of a magnetic field. The strength of this field is dependent upon the amount of current; and if the conductor is wound in the shape of a coil, the field of each wire adds to the field of the next so that the strength of the resultant field is dependent also upon the number of turns in the coil. Figure 4 shows the direction of a magnetic field around a conductor. It will be noted that the direction of current flow is considered as being from positive to negative.

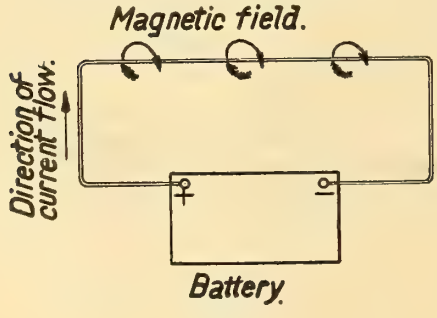


Figure 4

In Figure 5 we see what happens to a magnetic field when a conductor is wound in the form of a coil.

A very simple mechanical rule will tell the direction of a magnetic field when the direction of the current is known. The right-hand rule, as it is known, is applied by imagining the thumb of the right hand pointing along the conductor in the direction in which the current is flowing; the fingers then point in the direction of the magnetic field around the conductor. By the "direction of current flow" is meant the direction of flow as is indicated in Figures 5 and 6: that is, the conventional regard of current flow from positive to negative and directly opposite to the electron flow.

The illustrations consider the case of direct current. With a reversal of current the magnetic field reverses and follows exactly the reversal of the current. This is an important fact, because it is one of the basic laws of electricity that a change of strength of a magnetic field will induce a voltage in any conductor in the field. If the current through a coil is changed, the changing magnetic field will induce a voltage in the conductor forming the coil. The magnitude of this voltage depends directly upon the speed with which the field changes and upon the number of turns in the coil.

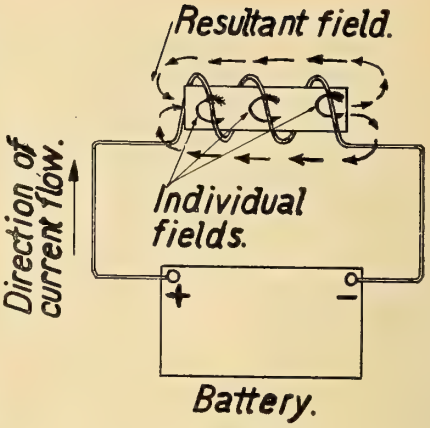


Figure 5

If iron is put into the center of a coil, a greater magnetic field density exists, because iron offers less resistance to lines of the magnetic field and they tend to crowd into the iron.

The phenomenon of self-induction just discussed introduces the conception of inductance which we shall discuss in detail in subsequent articles.

New Film Impregnation Process

ADDING life to negative and positive films is the claim of American Recono, Inc., of New York, which has two processes that will restore damaged prints and preserve them for future use, each adaptable to color positives. The processes do not consist of lacquers nor coatings, but operate by the impregnation of certain chemicals into the emulsion or celluloid sides of the film.

By the Rejuvenation Process, scratches and other mechanical abrasions are removed from both emulsion and celluloid sides of negatives and positives. A 75 per cent to 100 per cent removal of scratches is effected on the emulsion side if even the thinnest film of emulsion remains in the bases of the scratches. Dried or even brittle film is restored to its original elasticity; and in addition, given a glossy emulsion surface. Eight weeks' run positives are thus rejuvenated to first or second week's run quality.

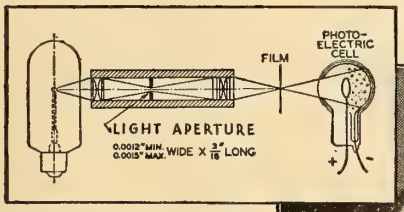
50% Efficiency Increase

The Impregnation Processes increase the elasticity of the film by at least 50 per cent. Thus buckling is minimized. The resultant greater play in the sprocket holes reduces perforation damage. The emulsion side is given a high gloss surface impervious to oil and moisture penetration.

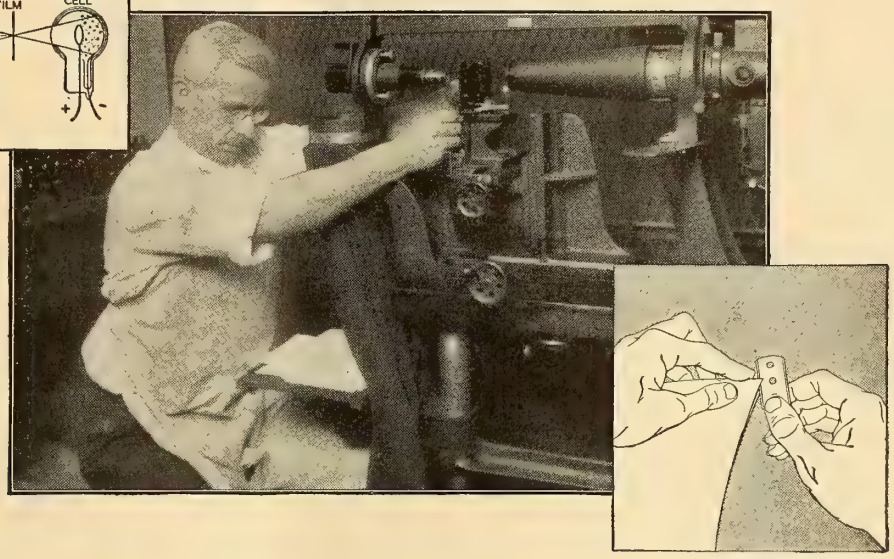
The surface of the emulsion itself is hardened, making it more resistant to scratches. The Impregnation Processes actually cements the emulsion to the celluloid base so firmly that it can only be removed with sharp metal instruments. This makes it much less likely that all the emulsion will be removed when scratching occurs. Impregnated negatives will print several times more positives before graining or mushiness set in.

All the processes result in a definite improvement of the brilliancy and plasticity of the projected photography. The interstices between the emulsion granules are impregnated with a substance homogeneous in its light transparency with the granules: this results in a reduction in light spraying or diffusion, and accordingly, in a straighter light path. Thus, treated negatives print better positives; which, in turn, can be further improved when treated. Treated color-positives show a striking improvement in brilliancy and resist smudging for weeks. The effect on the sound-track is an improvement in the clarity of the tone.

THE SIXTH OF A SERIES ON QUALITY REPRODUCTION *by* WESTERN ELECTRIC



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Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

MAKING good changeovers seems to be a great difficulty to many projectionists. I have found that the cue sheet supplied with the print is of little value after the print has been used for some time. This applies mostly to movietone, because after a print has played several theatres, many frames are cut off the ends of certain reels while making up 2,000-foot reels and many film exchanges are requesting that movietone subjects be run on 1,000-foot reels, so that good changeovers may be made on an indicated cue, without cutting off important dialogue.

Making changeovers has been simplified by the use of a cue meter, which is in use in many theatres, and considerable credit is due to Charles Reise, chief projectionist, and James Graham, projectionist, at the Fox Carthay Circle Theatre, for this new development. These cue meters can be used for making changeovers on disc and movietone subjects. This cue meter has two hands and a dial, which indicates the footage of the reel numerically. A flexible shaft is attached to the shutter shaft of the projector mechanism, which extends to the instrument on the front wall near each projector. The correct footage of each reel from the starting frame to the end is obtained by the use of a footage meter.

When threading the projector, the starting frame is threaded to the projector aperture and the total footage of the reel is set on the cue meter and as the film passes through the projector mechanism, the footage decreases on the dial of the cue meter. When the hand comes to the last one hundred feet, the arc is struck on the proceeding projector, and as the hand comes to the last twenty-five feet this is a stand-by cue; when the hand reaches the last ten feet this is the start motor cue for the proceeding projector, and finally the dowsers are operated and the changeover is made with one and two feet of the end of the reel, which makes a perfect changeover. This new instrument eliminates the long written cue sheet, which requires considerable time to arrange.

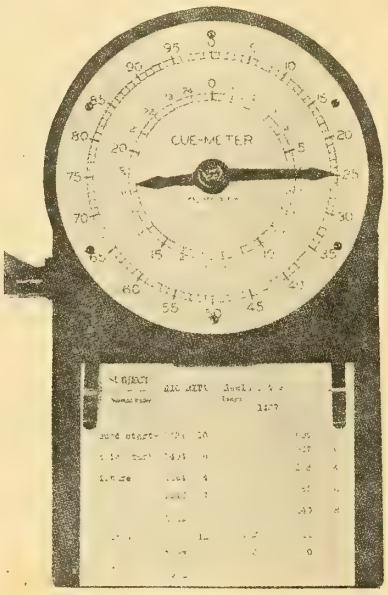
Many projector mechanisms are equipped with a footage meter, which can be used for the purpose of making changeovers. When making changeovers with the footage meter on the projector, set the meter at zero with the starting frame. The footage meter will increase as the film passes through the projector and changeovers can be made similarly as mentioned with the use of the cue meter.

Re-Synchronizing Disc Prints

The cue meter is also useful for re-synchronizing disc prints. When the film breaks above the top sprocket, it is necessary to stop the projector, rewind the reel and start all over again. As an example, suppose the film broke above the top sprocket and the projector kept running for several feet and you stopped the projector. You will find the footage indicated along the edge of most disc prints. The film broke leaving seven frames past 635 feet. The total footage of the reel was 920 feet and the cue meter showed 275 feet left to be projected after the projector was stopped. Turn the projector back, by the use of the flwheel on the projector motor shaft, leaving the reproducer arm with needle on the record groove until the cue meter reaches 285 feet and then thread the frame, which is numerated along the side of the film at 635 feet, to the projector aperture, and then run the film down so that sufficient length is adequate for rethreading the remainder of the mechanism. After threading the projector, it is possible to resume operation in perfect synchronism, without the long interruption which takes considerable time to rewind and rethread.

Photo Electric Cell

When sound equipment is functioning properly, leave it alone. It is advisable not to try methods of "shooting" trouble until the proper time comes. A few conditions have come to my attention where sound equipment has been totally disabled, because experiments were being made. Common sense is still requisite in maintaining power amplification systems. Secure more data and spend more time on the study of your particular equipment. The photoelectric cell amplifier has given more consistent trouble than any other part of the Western Electric sound equipment. I not only mean trouble, but it has been the cause of poor sound reproduction in many theatres and many interruptions.



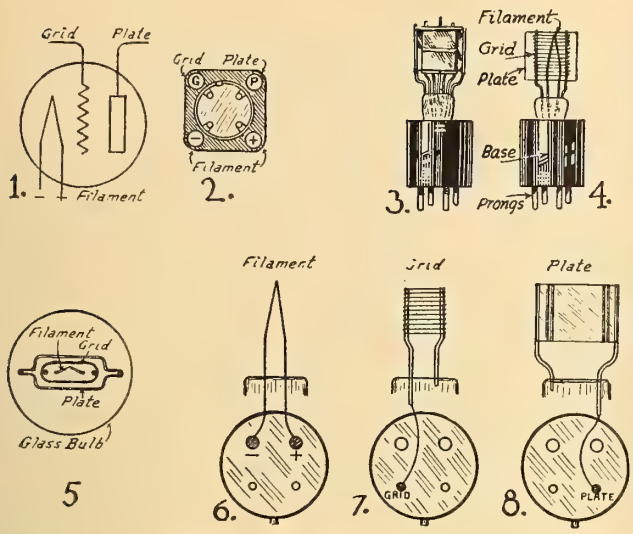
Cue meter which eliminates long written sheets and facilitates changeovers

If you are getting distorted sound through the Movietone system, check the alignment of the photoelectric cell and see that the ring-shaped conductor and window are in parallel position with the sound aperture, as it is imperative that the full beam of light is received by the photoelectric cell. When photoelectric cells are changed, see that all connections are tight and keep in mind that the photoelectric cell is installed in such a position that it accepts all the vibrations set up in the projector and if the connections are not tight, they will work loose and considerable noise will be encountered. When the volume begins to drop slowly on either movietone attachment, it is an indication that the photoelectric cell needs replacement, or the potential is weak.

Always be positively sure that the exciting lamp is operating at the proper value and is properly adjusted, before changing the photoelectric cell. When the volume cuts off quickly with movietone, first see that the exciting lamp is burning, check the milliammeter on the photoelectric cell amplifier.

The filaments of the vacuum tubes in the photoelectric cell amplifier are connected in series; if one tube burns out, they all go out, and if no reading is registered on the milliammeter connected in the filament circuit, check for a burned-out tube. If the exciting lamp ammeter and the photoelectric cell amplifier milliammeter indicates no values, check for a blown fuse in the battery charging panel.

The exciting lamp current and also the filament current for the photoelectric cell amplifier is supplied by two 6-volt wet storage batteries, which is distributed from the battery and charging panel to each projector movietone attachment. The photoelectric cell potential and also the plate potential for the photoelectric cell amplifier is supplied by two 45-



Vacuum tube assembly. Figs. 1 and 2 are the symbols for tube and terminals on socket. In Figs. 3 and 4 are the tube's principal parts. Fig. 5 indicates relative positions of elements in a tube; and Figs. 6, 7 and 8 show connections between tube elements and base prongs looking at bottom of tube

volt dry "B" batteries. The one amp fuse connected in this circuit very seldom blows, unless one of the component parts in the amplifier becomes shorted.

Testing for Sound

After the photoelectric cell or other part is replaced and all meters register their proper values, the quickest way to test for sound is to pass your finger up and down through the light beam with the light gate removed and the fader set on the normal operating point. While making this test, with patrons in the auditorium, turn off the stage horns. Leave only the monitor horn turned on for your convenience. If no sound is heard, touch the positive terminal leading from the photoelectric cell. A very distinct click should be heard through the system. If this is heard, replace the cell as many photoelectric cells are found to be defective.

Never start up a sound projector unless you are positively sure that sound is coming through, as it is very embarrassing to start a projector with motion on the screen and without sound, and have to stop again. If one of the photoelectric cell amplifiers is picking up machine noise, look for a tube, which is not inserted properly in the socket.

On many occasions I have found wires in the photoelectric cell amplifier touching some component part and the vibrations set up in the projector would be carried through the entire system. It is necessary to inspect the photoelectric cell amplifier quite frequently and see that no obstruction is in the path of preventing it to swing freely. Because of the high impedance in the photoelectric cell circuit, it is necessary for the positive lead from the cell to the input terminal, on the amplifier, to be as short as possible without being so tight that machine noise will be picked up.

Vacuum Tubes

WITHOUT the vacuum tube, power amplification would be impossible. Until the advent of vacuum tubes, power amplification was unknown and all speech and music was heard with headphones. A vacuum tube appears as a glass bulb. The bulb is supported on a base made of moulded insulating material. From underneath the base protrude four prongs through which connection is made to the internal parts of the tube. The part which is most apparent is a smooth shining piece of metal which encloses a collection of wires. This is called the plate. Inside the plate is a flat spiral of very fine wire. This is called the grid. Inside of the grid is a V-, or M-shaped, wire. This is called the filament.

On one side of the base of some vacuum tubes is a small pin which acts as a guide, when inserting the tube in a socket. The two ends of the filament connect to two of the four prongs on the base. In some tubes, which have two of the prongs larger than the other two, the two larger prongs are those connected with the filament. One prong is connected to the grid and the other prong is connected to the plate.

All wires and supports are carried in a piece of glass which is passed tightly around them. With the plate, filament and grid in position and assembled inside of the glass bulb, almost all of the air is exhausted from the bulb and it is then sealed to form what is usually called a vacuum tube. The symbol shown is generally used to indicate a tube containing filament, grid and plate.

The filaments of vacuum tubes are usually constructed of tungsten wire. The plate is constructed of nickel and surrounds the filament and is completely insulated from it. The filament of the vacuum tube is heated by connecting it to a battery called the "A" battery or by rectified A. C.

A positive charge is placed on the plate, by connecting it to the positive terminal of a "B" battery or by rectified A. C. Vacuum tubes as rectifiers have an important application in some amplifier circuits, which will be explained in the near future.

Care of Horn Units

I visited a theatre recently and found the sound entirely cut off on one side of the auditorium. There were two 15-A type horns installed, one alongside of the other. Upon inspection I found one of the horn units dead. The manager advised me that his patrons had been complaining about the sound on that side of the auditorium for the past two nights.

There is positively no excuse for this condition. Anyone can tell if the sound is cut off on either side of the auditorium. Frequent visits must be made during the sound picture presentation to various parts of the auditorium. If you are in doubt about the sound coming from the horns, go back stage and find out definitely if all the horn units are functioning.

Replacing Units

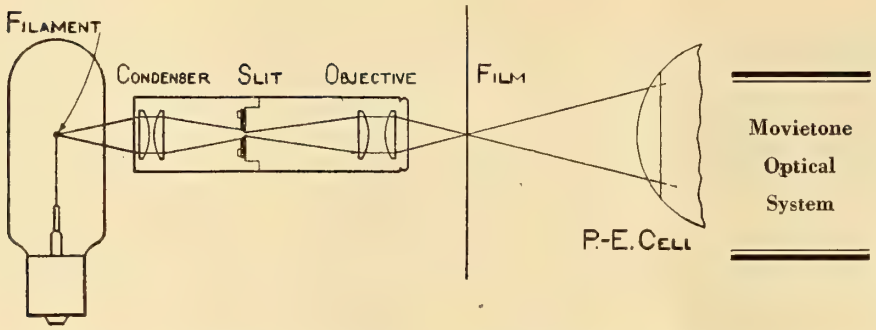
Changing horn units is not a difficult job and it does not require an

PROJECTION ROOM TUBE RECORD

TYPE TUBE NO._____

TUBE NO.	DATE REC.	DATE USED	DATE TAKEN OUT	APP. HOUR USED	TUBE NO.	DATE REC.	DATE USED	DATE TAKEN OUT	APP. HOUR USED

Vacuum tube log form which is standard in Fox West Coast theatres



engineer to do this work. To replace the Western Electric 555-W horn receiver unit, take off the wires on the four terminals and with a wrench provided, loosen nut and lift off receiver. Replace it with one of the tested spares and be positively sure that each wire is connected to the same terminal on the new receiver as it was connected on the defective one. If the wrong connection is made to receiver terminals the quality of reproduction will be spoiled.

Electrical Research Products, Inc., have a standard color combination, which is used between the terminal strip in the "B" box and the horn units to determine the correct polarity. The speech leads are connected to L-1 and L-2. The color combination for these leads is red and green. The red tracer, which is positive, should always be connected to terminal L-1 and the green tracer, which is negative, should be connected to L-2.

The field coil leads are also polarized by color combination. The black tracer lead is positive and should always be connected to terminal 7V+ and the plain white lead, which is negative, should always be connected to terminal 7V—. It is necessary that these color combinations be memorized, so that horn units can be changed quickly.

W. E. "B" Box

The Western Electric "B" box, which most of you are familiar with, is the termination for speech leads and also the field coil leads for the 555-W Western Electric horn units, which is located either on the rear wall or the side wall back stage. A 1¼" conduit, which is run from the A box in the projection room to the B box back stage carries the speech and field coil leads. The number of wires which are in this conduit are subject to the number of horn units being used.

A terminal strip, also switches and fuse blocks are inside of the "B" box. The speech leads run to the terminal strip and are indicated for polarity by the colors—black and white. Black is for positive and white is for negative.

A pair of wires are run for each speech circuit for each horn unit. Usually the wire size is No. 14 for the positive leads and one neutral of No. 8 wire is run, which takes care of the common leads to complete each speech circuit. From the terminal strip two conductors, of the four conductor horn cable, are connected to the speech circuit which extends to the horn unit. These conductors are polarized by color, as mentioned before.

The magnetizing current, which is supplied to the field coils of the 555-W Western Electric receiver, is supplied by two leads. These two battery leads are controlled by the horn switch in the projection room. The wire size is usually No. 10, when four horn units are used. However, the wire size is governed by the distance between the stage and the projection room. When four horn units are used, the two battery leads feed four switches and fuse blocks. The other two conductors of the horn cable are connected to this source of D. C. supply. These conductors are also polarized as mentioned before and extend to the horn units.

Fuse Blocks

If one of the horn units ceases to function, inspect the fuses for that horn. The fuse blocks are usually marked for each horn. Keep in mind that these fuses are only for the field coils and not for the speech circuit. The magnetizing current for the 555-W Western Electric receiver is 1.5 amps. The speech circuit may be tested at the terminal block in the "B" box or across terminals L-1 and L-2 on the receiver with head phones.

When sporadic hissing, crackling and frying noises are perceptible in sound reproduction, it is advisable to inspect the amplifier tubes for internal short circuits. The filaments of vacuum tubes deteriorate more rapidly than the plate and the grid. As the tube filament ages it develops weak spots in one or more places, which are very apparent, because they glow more brightly than the rest of the filament when lighted. The tube should be immediately replaced if such a condition is noticed.

Many vacuum tube filaments become slack and develop sagging as they age. Such a condition will give undesirable results and besides, it is possible that the filament may drop over on the grid and cause consideralble trouble. Replace the tube as soon as the filament begins to droop noticeably.

Vacuum tubes supported in a horizontal position, such as the tubes, which are used in the 8-B and 9-A Western Electric amplifiers, should be inspected quite frequently for saggy filaments. Where a meter is provided on the amplifier for the purpose of checking plate current values and when the plate currents begin to fall below the minimum values, check the amplifier tubes, and if all tubes show low plate current at the same time, the fault probably does not lie with them but may be due to the rectifier tubes.

Optical Systems

Movietone attachments require careful attention, and this is one reason why the quality of film reproduction is spoiled in many theatres. The reproducer or exciting lamp is one of the most important factors. A sharply focused slit on the sound track cannot be obtained if the lamp is dirty. A finger print on the bulb in front of the filament obstructs the image. Dirt of any kind in the filament image path will reduce the volume and, besides, certain high frequencies will be eliminated.

The filament of the exciting lamp must be absolutely horizontally level to produce best results. A saggy filament is very detrimental, as it does not coincide with the slit. Discoloration of the bulb, with which most of you are familiar, will cause loss in volume.

We are using the General Electric reproducer lamp, which is rated at 4 amperes, 8 volts. Many lamps deteriorate in less than 100 hours burning service, because the current is controlled recklessly. 3.9 amperes is the burning rate efficiency with sufficient incandescence. Verify the ammeter reading connected in the exciting lamp circuit to confirm that the lamp is not burning over the value of 4 amperes. The current values should be identical for the exciting lamps of both projectors, and if they are not the same, a change in volume will be noticed.

Checking Vibration

It has happened that the filament would become deteriorated and loosen, so that vibrations emanated in the projector would jar the filament to such an extent that it would be perceptible in reproduction. Exciting lamps should be inspected quite frequently for this trouble. Electrical Research Products supply extra exciting lamp holders with each installation. It is imperative to keep a good lamp installed and properly adjusted in each spare lamp holder.

The respective projector, for which the exciting lamp and the holder are adjusted, should be identified and placed near the projector for immediate use. In many instances, when an exciting lamp burns out, a scramble is made to find the spare unit for that particular projector and meanwhile the patrons in the auditorium are needlessly waiting because of your negligence. The R. C. A. Photophone sound mechanism is pro-

vided with three exciting lamps, which are mounted on a turret. When one of the lamps burn out, all that is necessary to resume operation is to rotate the turret to the next lamp. The adjustment of the exciting lamp should be considered similar to that of adjusting the illumination on the projection screen.

Lamp Adjustments

The ERPI exciting lamp bracket is provided with four adjustments. The focusing adjustment, vertical and sideways adjustment, and clamping adjustment. It is necessary, for eye comfort, to reduce the brilliance of the light while adjusting. In the side of the lens tube is a small round window, which contains a very narrow horizontal slit. The light falling on this slit should be bright and sharply focused and perfectly centered. With the light gate removed, hold a white card up against the opening which goes to the photo-electric cell.

The light projected should be clear and uniform; however, the edges of this spot will be blurred. Shadows at the top, bottom and sides can be eliminated with adjustments provided. Make the necessary adjustments until the shadows disappear, but do not change the focus as set forth. Positive operation is what we are striving for. The exciting lamp requires frequent attention. Movietone is not an infant. Why should it sound like one?

H. & C. Wide Film High Intensity Lamp

By THEODORE HALL*

WE have recently developed a new type projection lamp for use on Grandeur and other wide film installations. The lamp is known as Type FR-10 and is rated at 120 to 225 amperes. In order to construct a burner to stand up under this tremendous current and attendant high temperatures, it has been necessary to depart from what had previously been considered standard practice in lamp design. It became necessary to consider this new lamp in the light of a high power electric furnace and to carry out the design accordingly.

Consequently the outlines of the new outfit have taken on a new and, to we projectionists, entirely unfamiliar form. But the new shape is one that is pleasing to the eye and conforms more nearly to the newer and more massive projection machines.

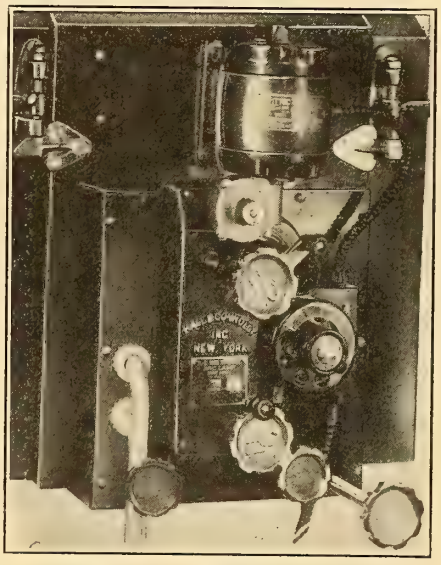
Many New Features

Aside from the new type burner used in this outfit, special attention has been given to the proper kind, shape and size of condenser lenses, the proper mounting of same and special means for protecting them from breakage. Something entirely new has been devised in the manner of ventilating the lamphouse so that the hot gases from the arc are removed as soon as they are generated and cool air introduced in large volumes against the sides of the burner without disturbing the arc.

Heretofore in all high intensity arcs used for motion picture projection the long arc flame leans forward at about 20° to 40°, depending on how steep is the angle of the negative carbon. This has always been a great difficulty inasmuch as it endangered the condenser. Even with the old 4½″ diameter condenser great care and discretion had to be exercised by the projectionist to prevent the top of the lens from becoming sooted and broken.

In the new FR-10 lamp this fault has been overcome. By a magnetic effect, proper direction of the air currents around the arc, and by a suitable angle of the negative carbon, we have succeeded in directing the flame and holding it nearly perpendicular to the positive carbon, thereby permitting the use of 6″ or larger condensers with fine results.

*Hall & Connolly, Inc.

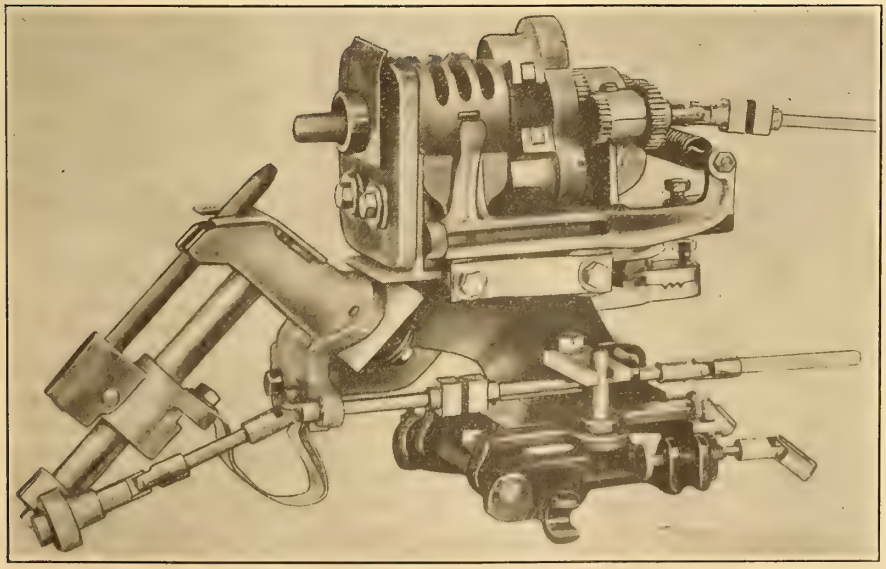


Rear view of new lamp showing controls

The new FR-10 lamp is equipped with special 6″ diameter condensers. The front condenser is parabolic-meniscus and can be used for either standard film or wide film projection. The back condenser has a special curve for wide projection and a similar lens for ordinary projection. The distance from the tip of the positive carbon to the face of the inner condenser is from 3½″ to 3¾″.

Increase in Illumination

The calculated increase of illumination is about 60 per cent over any of the present systems in general use. The actual increase by test and measurement is from 45 to 50 per cent. These tests and calculations are based on the performance of the lamp on a standard projector. With the wide aperture the proportionate gain is greater.



Constructional details of new lamp mechanism

[*Note: The foregoing article by Mr. Hall will be supplemented at a later date by more detailed information on the new H. & C. lamp after an opportunity for close observation of its performance over a period of time is had.*—The Editor.]

As The EDITOR Sees IT

¶ *The Future of Color*

COLOR is regarded as one of the triumvirate of new stalwarts of motion picture production and reproduction, the other two being third dimension and sound. The latter has demonstrated its worth; depth is still to come; and we make bold to say that color, while very popular just now, is far from what its proponents say it is—far from what it should be. No motion picture in color, or with color sequences, is today advertised without emphasis on color. In some instances even the stars are shunted to a minor place in advertising layouts to make room for a gaudy display of the color tints to be viewed in a given production. As a means of bestirring additional interest in pictures this is all very well; but color may not honestly be ballyhooed as a technically correct achievement.

After viewing one color production after another in the last six months we find ourselves yearning for the conventional black and white film. This latter, with its sharp contrasts between light and dark, its subtle shadings, is more dear to our hearts in these spangled days of color than ever before. Done in the manner of "Interference"—to mention only one of a great many black and white technical masterpieces—black and white puts to shame some of the present day examples of color—color which appears to us many times of late as only a smudge.

Let us have color, by all means; but let us have *color* and not a hodgepodge of color. Failing this, let us be content once more with the satisfying tones of the well-done black and white.

¶ *The Projection Advisory Council*

THE Projection Advisory Council is just one year old this month. Within the short space of twelve months, and despite the difficulties attendant upon the organization of a society of this kind, the Council has been able to do much good work in the interests of projection and projectionists. Naturally, one cannot expect too much from an organization in its first year, particularly in view of the fact that much of the time was spent in actual organizing. However, the Council has been responsible for much that is good, and it seems destined to do even better in the future.

As is customary in launching such endeavors, the work of organizing the Council has been hampered by a lack of cooperation among the very people who will ultimately reap the greatest benefits from the work of the Council. Many who publicly express their hearty approval of the Council, its aims and endeavor, are those who will not themselves lend a hand to help the organization. We say this not in a critical vein but rather in the spirit of pointing out the fact that no organization can go far unless those whom it seeks to aid lend their money and their efforts. Council membership, while approximating a healthy total for a society so young, is not quite what it should be. The cost of a membership is quite reasonable; and it is only through the medium of a greatly increased membership list that the Council may forge ahead—may accomplish much necessary work.

It seems to us that provision could and should be made in the ensuing year's budget for a membership in the Projection Advisory Council. The Council may now be in a position where it requires a little help, but who can say that the day will not come when one will need the help of the Council? We have been privileged to become aware of some of the Council's plans for the next year, and we say unhesitatingly that a membership for every individual projectionist and all those interested in motion picture projection will be among the year's best investments.

¶ *Selenium vs. Photo Electric Cells*

ALTOGETHER too much prejudice is attached to the use of the selenium cell for sound motion picture work. Photo electric cells are used for this work and are accepted by a majority of workers in the art as the "last word," without even a thought to available data covering both new and old researches into the use of selenium which tends to show that the latter might well be accorded serious consideration as a means for improving present technique. As a matter of fact, there are but few people who know that selenium *has* been successfully used in sound picture work. The general impression seems to be that well enough should be left alone; the photo electric cell is here, it works satisfactorily, and that's about all there is to the matter.

However right this opinion may be, it cannot be denied that the following data with regard to selenium is correct: (1) a 6-volt C battery is all that is needed to make it function, (2) less amplification is required than is used with a photo electric cell at 150 volts, (3) a selenium cell may be used with good results in any conventional circuit, (4) no patent situation can truthfully be said to exist with respect to selenium cell use, and (5) the cost of a selenium cell is but $5; contrast this to the present price range of photo electric cells, not forgetting the "breakage" factor of the latter.

Selenium cells present so many interesting possibilities with respect to their use in sound motion picture work that we have resolved to present soon in these columns a symposium on the matters discussed above.

Some Characteristics of Sound

The following brief explanation sets forth laws and theories governing the recording and reproduction of sound —what sound is, how it acts on the human ear, the receptive qualities of the latter, the "frequency" range, and difficulties in recording and reproduction.

ALL sounds are vibrations. What seems to the human ear to be a note of a certain pitch, tone and timbre, is nothing but a complex series of vibrations transmitted through the air to the ear drum. These vibrations can actually be seen photographed in black and white on the sound track of a sound film; they can be felt by placing the hand on the diaphragm of a loud speaker. The vibrations which affect the ear drum are termed audible vibrations and range from about 20 per second to 20,000 per second. (In ordinary recording practice the range does not run quite as low nor as high as this.)

What we call a low note is a slow vibration of the ear drum. A high note is a rapid vibration of the ear drum. When hearing a sound, the ear drum is actually vibrating in unison with the sound source. Electrical and acoustical engineers call these vibrations "sound frequencies." A *frequency* of 1,000 applies to a sound having 1,000 vibrations per second. The ear can detect frequencies from 20 to 20,000 but not with the same degree of sensitivity for the entire range. The ear is most sensitive to frequencies between 550 to 4,000.

If two notes are produced at the same time—say, one of about 150 frequencies and another of 1,000 frequencies—it will be noticed that the low note has a masking effect and drowns out the high note. It is an accepted fact that most low pitched notes have a masking effect over the high tones. This is proven in the laboratory with two tuning forks of a different pitch. The higher pitch tuning fork becomes inaudible when the low pitched one is vibrating.

When experimenting with a frequency selector it is found that the energy and volume of speech is located in the lower frequencies from 20 to 1,000, but the characteristics necessary to proper pronunciation and articulation are located in the higher frequencies, 1,000 and up. In other words, without the high frequencies it is impossible to reproduce clear, distinct speech. Music is easier to reproduce because the frequencies are not as complicated and the range for most instruments is from about 16 to 4,000 frequencies. The low frequencies give the volume and timbre, the higher frequencies the brilliance and overtones.

Pronunciation of English entails the use of about 40 different sounds located in different parts of the frequency range, or from about 30 to 9,000 frequencies. The voiced sounds are produced by the vocal cords in the larynx and they possess most of the energy and volume of speech. Most of these sounds are located in the lower register. The unvoiced sounds like *p, k, t, f, s, ch, th,* so called because the vocal cords take no part in their production, have a hissing frictional nature and are produced by the flow of air between the teeth, lips and tongue. Most of these sounds are high pitched running up to 9,000 frequencies. They are also much weaker than the voiced sounds. Some voiced sounds have ten thousand times more energy than unvoiced sounds. As stated previously, these higher pitched unvoiced sounds are absolutely necessary to the distinct rendition of speech.

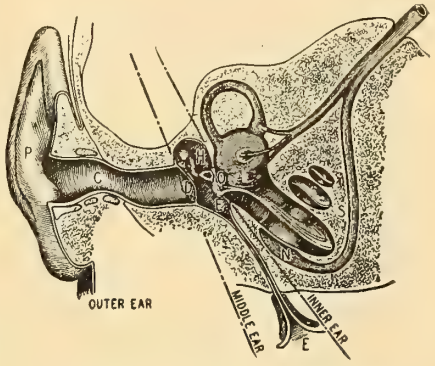
All these factors combine to make the recording and reproduction of speech difficult. The recording engineer has three major problems to meet. These three problems are based on the following propositions:

(1) The sensitivity of the ear decreases very rapidly over 4,000 vibrations.

(2) The high frequencies in speech are initially much fainter than are the lower frequencies.

(3) The high frequencies are subdued and drowned out by the masking effect of the lows.

The highs also suffer losses from various other incidental causes. Due to the beam effect the microphone will not pick up the high frequencies successfully unless the speaker faces the microphone. The period of reverberation of the set favors the low frequencies. The microphone also has a tendency to favor the lows if it is located near draperies, padded walls, and other absorbent material. As a result, the recording engineer attempts to make a compromise to please the majority; and it is inevitable that every studio staff should have slight differences of opinion as to how best to please the majority.

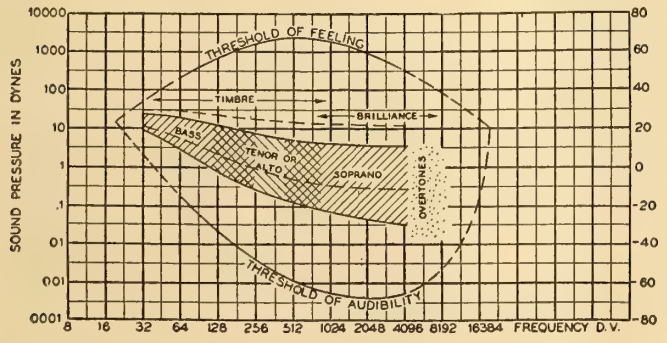


Cross-section of the ear canal, showing its complex structure

We must also remember that "duping" from film to disc and from disc to disc is responsible for a large percentage of frequency losses. The recording engineer turns to selector and rejector circuits for a solution of his problems—to attenuate unwanted frequencies and to accentuate and emphasize the desirable frequencies.

In the theatre another series of troubles arise. Every theatre has a different resonance. Every make of pick-up, fader, amplifier and speaker has a different frequency response. The capacity of the lines running between the above units has an effect on reproduction. Recordings which reproduce splendidly in one theatre are "duds" in another, owing to these varying conditions.

The studios have gone far along the way of correcting most of the ills of sound recording by utilizing such aids as frequency selectors, etc., but the needs of the theatre with respect to improved reproduction seem to have been overlooked. That which has been of such great aid in studio practice might well be employed to do the same work in reproduction. Sound in theatres requires more brilliance and depth, a more natural and pleasing tone.



Constant loudness lines are not quite horizontal but slope down with increasing frequency as shown

Voltage and Power Amplifiers

I. *RCA Photophone System*

BOTH the voltage and power amplifiers used in RCA Photophone equipment are of the type known as push-pull amplifiers. The reason for the use of such a term as "push-pull" when applied to an amplifier will become apparent after its action has been explained. Two amplifier tubes are used in each stage of amplification and are connected so that each tube aids the other in amplifying the electrical impulses to be passed on to the next stage. A current is induced in a coil of wire when magnetic lines of force are passed through it. The direction of this current depends on the polarity of these lines of force and the direction which they are moved past the coil. If either the polarity or the direction of motion is reversed, the direction of the induced current will be reversed. If both the polarity and the direction of motion be reversed at the same time, the direction of the current will remain the same as before. It is upon these facts that the action of the push-pull amplifier is based.

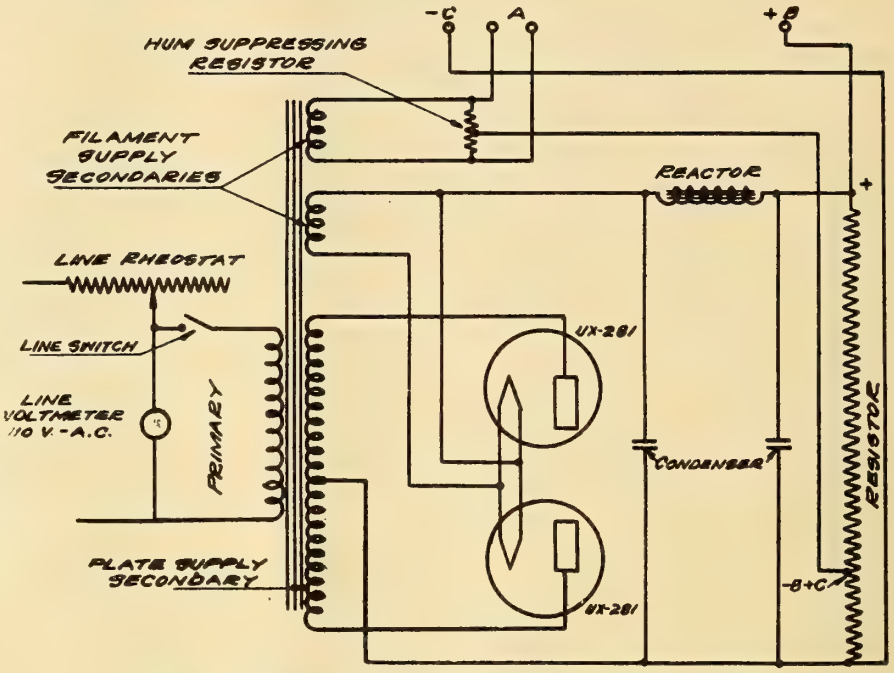


Fig. 2. Elementary diagram illustrating full-wave rectifier

As further explanation of the above statement, it may be said that an increasing current in the primary of a transformer causes an expansion of the magnetic lines of force and induces a current in the secondary, and also that a decreasing current in the primary causes a collapse or "shrinkage" of the lines of force which induces a current in the secondary in the opposite direction. If, however, the direction of the current in the primary be reversed, the polarity of the lines of force would be reversed and an increasing current will induce the current in the secondary in the same direction as a decreasing primary current before the reversal.

Input Transformer

The input transformer of a push-pull amplifier has what is called a "split" secondary; that is, the secondary has a connection brought out from its electrical center. (Fig. 1.) This lead is connected to the grid ("C") battery, and the two ends of the secondary are connected to the grids of two amplifier tubes. These grids are kept at a certain negative value by the "C" battery. When an alternating current is fed into the primary of an input transformer, the action of the transformer is such as to render the grid of tube No. 1 less negative when the grid of tube No. 2 is made more negative, and vice versa. This causes the plate current of tube No. 1 to increase when the plate current of tube No. 2 decreases, and the reverse is also true. The plate current of the two tubes comes from the plate ("B") battery into the "split" primary of the output transformer at its mid-connection. Here the current divides, and half of it flows upwards into tube No. 1 while the other half flows downward into tube No. 2, which tends to produce magnetic lines of force around the two halves of the primary in opposite directions.

Since the magnetizing effects of the two halves of the primary are equal and opposite and therefore neutralize one another, no lines are actually produced.

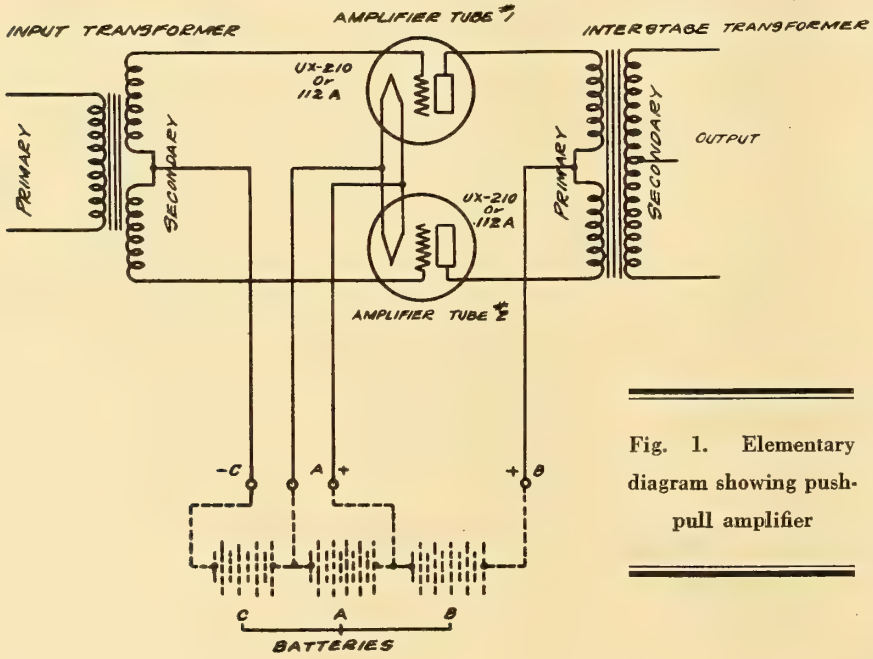


Fig. 1. Elementary diagram showing push-pull amplifier

Plate Current

When the plate current of tube No. 1 increases, the upper half of the primary coil tends to increase the number of lines of force in one direction and the decreasing plate current of tube No. 2 causes the lower half of the primary winding to decrease its strength in the opposite direction. This action results in an increase in the number of lines through the secondary coil, this increase is just twice what the increase

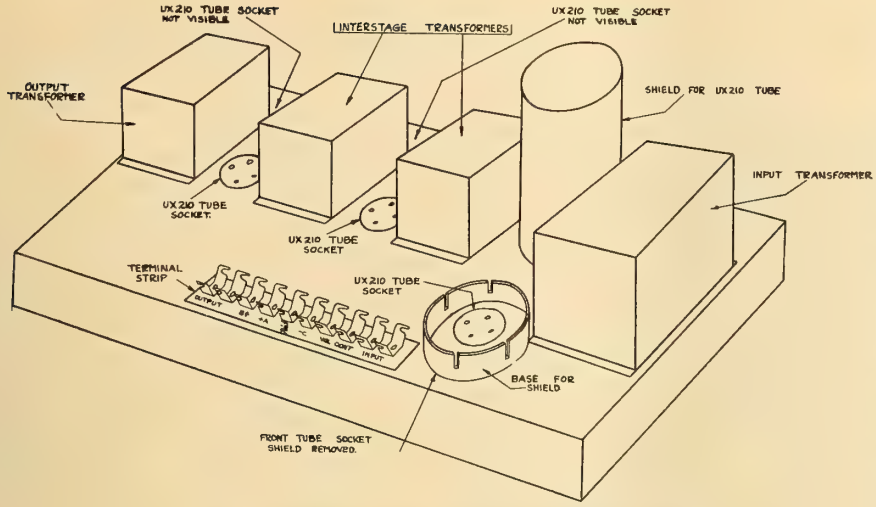


Fig. 3. Isometric view of voltage amplifier unit

would have been if there were only one coil.

To explain this action in other words, suppose each coil has a tendency to produce 100 lines through the secondary, but since they are in opposite directions, there are no lines present. If an increasing current in the upper half of the primary tends to increase the lines by 10 and a decreasing current in the lower half tends to decrease the lines by 10 in the opposite direction, the total change will be 20 lines in the direction of the increasing (upper) coil. If only one tube with a single transformer were used the change in flux, or the change in the number of lines, would be 10, and 10 only, while the use of the two tubes assisting one another makes a change of 20 lines. The action of these 20 lines in building up from 0 to 20 produces a higher voltage than could be produced by an increase of 10 lines from 100 to 110 since twice as many lines will move through the secondary windings.

This action is similar to that obtained when a weight is transferred from one pan of a beam scale to the other pan. It would be seen that the pan to which a weight was added would be moved down just twice as fast if an equal weight were taken off the other end at the same time.

Push-Pull Amplification

When the grid of tube No. 1 is made more negative and the grid of tube No. 2 is made less negative, the same action described above takes place but in the reverse direction and the secondary voltage of the interstage (or output) transformer is reversed. It would seem from this discussion that one push-pull amplifier stage should deliver twice the amplification of a one tube amplifier stage but, due to various limitations, such is not the case. A push-pull stage will amplify about 1½ times as much as a single tube stage.

The action of the push-pull amplifier may be likened to the operation of a railway hand-car by two men. When one man pushes down on one end of the hand-bar, the other pulls up on the opposite end and vice versa. In types "A" and "B" (MG) amplifiers, several tubes are connected in parallel on each side of the push-pull circuit. In other words, the circuit is the same but tubes No. 1 and No. 2 in the accompanying diagram would each represent two or more tubes—but always in equal number on each side of the circuit. The action of such an amplifier may be represented as an equal number of men on opposite ends of the hand-bar. Each side of a push-pull circuit acts so as to produce an amplified voltage in the secondary of the output transformer simultaneously and in the same direction.

One big advantage of the push-pull circuit from the projectionist's standpoint is that it will still operate with one tube in each stage inoperative, although it will be necessary to advance the volume control past its normal position.

The voltage amplifiers used in some RCA Photophone equipments are illustrated in Fig. 3. The input transformer, which is fed from the projector fader on the input control panel, is located on the extreme right. The two tubes in the first push-pull stage of amplification are shielded to prevent a howl from originating in the amplifier, due to sound feed-back. If the shield were not in place the vibration of sound waves in the air would vibrate these two tubes. Such a vibration would produce a disturbance in the electrical circuits, and consequently, after considerable amplification, a howl from the speakers. The other tubes do not require shielding, since sufficient amplification of external noise is not obtained to create a disturbance.

The output transformer of the voltage amplifier, shown on the extreme left of the diagram (Fig. 3), is connected to the input transformer of the power amplifiers.

Power Amplifier

A power amplifier of the type used with the voltage amplifiers discussed above is shown in Fig. 4, and its various parts are clearly marked. The power amplifier is a push-pull amplifier similar to the voltage amplifier but using the more powerful UX-250 tubes. This power amplifier unit obtains its operating voltages from the alternating current line through a full wave rectifier circuit instead of from batteries, as does the voltage amplifier. The full-wave rectifier circuit uses UX-281's which are different tubes from those used in the Tungar rectifier but otherwise operation is identically the same, except for the addition of a "filter" circuit.

This "filter" circuit is so called because its purpose is to "filter" or smooth out the pulsations in the plate supply which would inevitably result were it not used. A resistor is connected across the output of the rectifier circuit and the voltages used in the power amplifier are obtained by taking taps off the resistor. It works in the same fashion as the potenti-

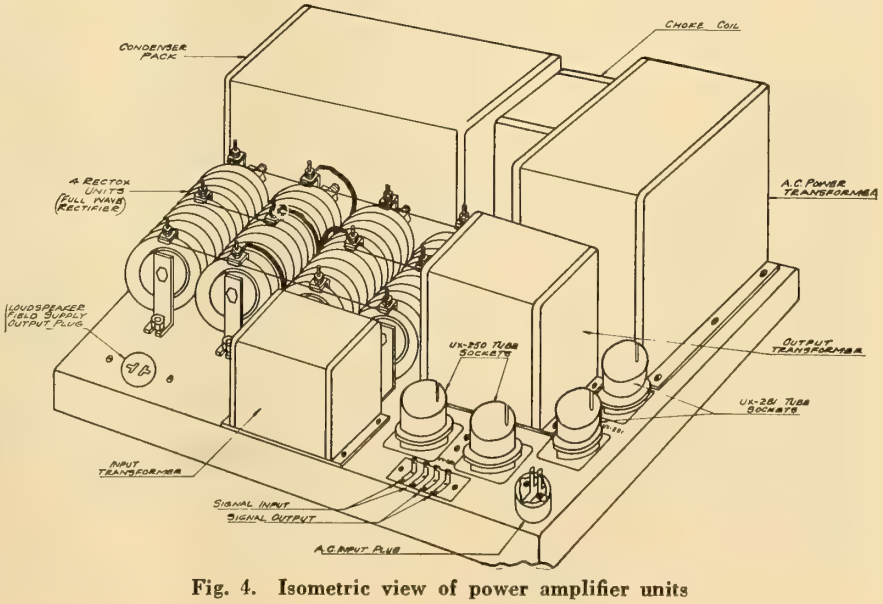


Fig. 4. Isometric view of power amplifier units

ometer except that voltages are taken off at fixed points along the resistor. The two UX-250 power tubes in the power amplifier are lit by current from a small secondary winding, and its plate voltage is obtained from the rectifier circuit. When the pulsating direct current from the rectifier is fed into the filter circuit (consisting, as shown in Fig. 2, of two condensers, and a reactor, otherwise known as a choke coil), the reactor tends to prevent the direct current from building up to its maximum value and as a result some of the direct current is stored up in the first condenser.

When the direct current begins to fall off, the condenser discharges into the choke coil and helps to hold the current to a steady value. It cannot discharge back in the other direction because, as indicated previously, current can flow through the rectifier tube in but one direction. The condenser on the opposite side of the choke coil does much the same thing. When the current tends to drop off from the filter circuit the charge which this condenser has accumulated while the current was building up is given off through the amplifier circuit, since this circuit offers a lower resistance to the flow of current than does the reactor.

It will be noted that the diagram of the push-pull amplifier shown contains an output transformer with two connections at the ends and one at the center of the secondary winding. This is the case where the transformer is to feed into another push-pull stage. If this is to be the last stage of amplification, and the output of this transformer is to drive the speakers, as is the case in the power amplifier, the output transformer secondary will not contain the center connection. In like manner, if the input transformer is connected from a preceding push-pull stage, its primary will have a center tap, which is not indicated in the diagram. These diagrams are not the same as the circuits used in the RCA voltage and power amplifiers or the rectifiers, but, although the wiring is different, the principles of operation are the same. The circuits actually used have been much refined by the addition of a number of small parts in various places in the circuit which if included in the accompanying diagrams would only serve to confuse the present discussion.

In normal operation practically no current flows in the grid circuit of an amplifier tube and therefore the chief requirement to be met by the amplifier stages preceding the tube is that the voltage of the electrical pulsations must be "stepped up" sufficiently to operate the tube efficiently. The voltage amplifier is used to increase the voltage of the incoming electrical pulsations to the proper value to operate a power amplifier. The power amplifier tube and its associated output transformer are "heavy duty" in the sense that they must be capable of delivering sufficient power to operate the loudspeakers connected to them.

In the power amplifier unit, in addition to the tune rectifier circuit, is contained a rectifier circuit made up of a number of metal discs chemically treated so that current can pass from one disc to another in but one direction. This is what is known as a "Rectox" unit. Such a rectifier is not sufficiently good for supplying the plate voltage of amplifier tubes as compared to the UX-281s. However, they will supply a much greater rectified current than will the tubes and are therefore used to supply the field current to the loudspeakers. The chief advantage of the "Rectox" units, aside from their current carrying capacity, is that they do not require regular replacement. Unlike a tube, they will last almost indefinitely when properly used.

Is the P. E. Cell a Fire Hazard?

By SAMUEL WEIN

WE HAVE been advised that one of the larger sound picture companies has listed the photo electric cell as a "fire hazard," accompanying the listing with the information that the cell has been known to "explode if wet." One correspondent asks if this information is "wet." We do not believe that the company referred to marks the cell package with the information that the contents are explosive but rather passes the statement along merely as a point of general information. We might say at the outset that such information is in some measure true but not to such an extent as to cause alarm.

It will be recalled that in the series of articles which appeared in these columns over a period of several months the photo electric cell was said to consist of a highly evacuated glass bulb, the inner surface of which is coated with a thin and homogenous film of alkali metal, e. g., sodium, potassium, caesium, etc. This film of alkali metal is deposited on the walls of the bulb by distillation while the tube is under vacuum.

These alkali metals are readily oxidized when exposed to the air. Were we to take a piece of alkali metal and allow a drop of water to fall on it, the metal would immediately burst into flames. This is due to the fact that the metal oxidizes so quickly and liberates hydrogen; and the affinity of hydrogen for oxygen is so great in its chemical combination that the hydrogen is ignited.

Were the liberated gases to be confined there would occur a serious explosion, the intensity of which would depend directly upon the amount of alkali metal used in the experiment. However, the amount of alkali metal distilled in the highly evacuated cell bulb is very small, and the "fire hazard" is reduced to an almost inconsiderable minimum. We find ourselves hard pressed to account for the presence of any great quantities of water in the projector sound head.

One possible source of difficulty lies in the chance that a certain photo electric cell might be what is technically known as a "slow leaker," which term is applied to cells which have a minute crack in the glass bulb, thus permitting the slow seepage of air into the bulb. Under such conditions the alkali metal oxidizes very slowly, making the cell unfit for further use. This loss of efficiency by the cell is indicated by its changed physical appearance.

On the other hand, should the cell drop on the floor and break, it will immediately ignite with a slight flame which will extinguish itself almost immediately.

Some photo electric cells are filled with a trace of an "inert gas," such as neon, argon, helium, etc. These gases are, as the name implies, *inert* and therefore are not combustible. It is possible that if a large number of cells were shipped together and should explode simultaneously, no little difficulty would ensue, but the combination of circumstances necessary to precipitate such an occurrence renders the happening almost impossible.

Patent Notes

W. E. vs. Stanley Company

Western Electric and Electrical Research Products won the first round of their suit against the Stanley Company of America for patent infringement, based upon the use of allegedly infringing Pacent equipment in some of its theatres, when the Federal Court for the District of Delaware at Wilmington dismissed the alternative defense offered by the Stanley Company on March 5.

In its reply to the filing of the suit by Western Electric, the Stanley Company set up the usual defenses and in addition, an alternative defense. This was the alleged right to use Pacent equipment in view of the Electrical Research Products' contract with the Vitaphone Corporation, because the Vitaphone Corporation and the Stanley Company are both subsidiaries of Warner Brothers.

At the same time the Warner Brothers and the Vitaphone Corporation filed a bill of complaint asking for an injunction to forbid further prosecution of the suit against the Stanley Company. The decision of the Federal Court not only dismisses this request for an injunction but also strikes out the alternative defense offered by the theatre corporation.

Grandeur Wide Film System

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

AS I stood in the projection room of the Carthay Circle Theatre in Los Angeles and watched the first presentation of Grandeur wide film I was filled with misgivings akin to those I experienced when sound pictures first were shown. There before me were the marvelous wide film mechanisms purring away — charting another milestone passed by the industry. There was the projection staff, alert, confident, sure-handed in their work. But what of the other men throughout the country? Would wide film presage another technical debacle similar to that precipitated by the introduction of sound? Would months pass after the installation of wide film equipment before the projectionist would know the equipment thoroughly? Would the sponsors of the various systems be in accord on standards?



R. H. McCullough

There is only one sensible way to dispel these fears. Let there be standardization of wide film equipment—let the bars be downed on all information requisite to putting on a good show—let's get together and put the show over right!

FOLLOWING its premiere in New York City, Grandeur, latest motion picture projection engineering marvel, has been introduced on the West Coast at the Fox Carthay Circle Theatre in Los Angeles by Fox West Coast Theatres. Grandeur is the result of joint development work by the Fox Film Company and the International Projector Corp., engineering work being done by both companies on production and reproduction, respectively. As with sound film, Fox leads the wide film procession. The Carthay Circle installation, while following the New York showing, may be regarded as the first *permanent installation* of Grandeur equipment, the New York showing being in the nature of a trial run in a house which may not be regarded as a regular motion picture theatre. Even the installation in the Roxy Theatre in New York is not a complete Grandeur projection room.

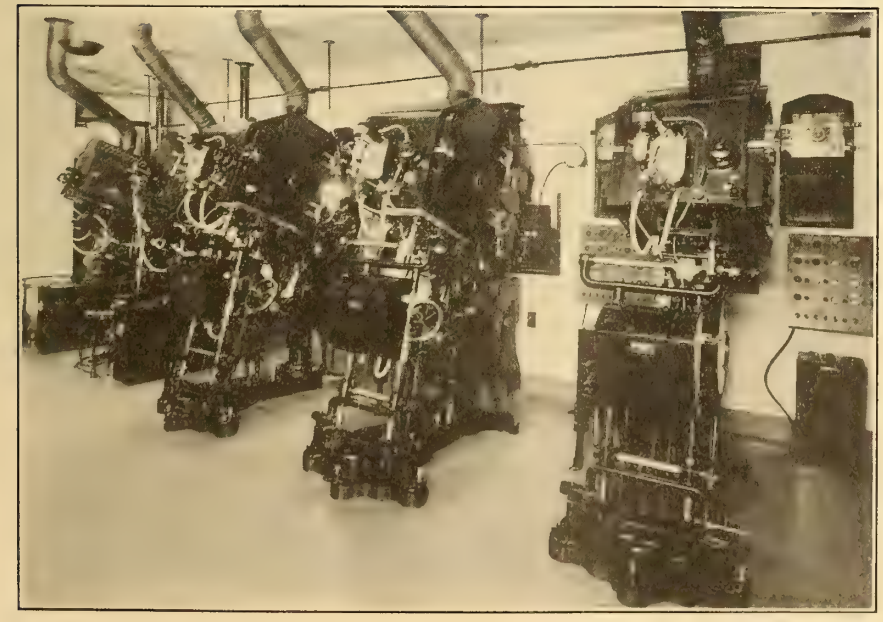
Several other film companies have plans for wide film, but with the exception of a few scattered private demonstrations, no further announcements have been forthcoming from the several sponsors. One of the crying needs of the present with regard to wide film development is standardization. Several attempts have been made to reconcile opposing viewpoints on this question, but nothing definite has come of these efforts. Exhibitors are in doubt as to their projection plans for the future, and there is much harmful loose talk making the rounds.

Presents No New Problems

New theatres now being planned have incorporated in their design ample allowance for wide film—all new theatres, in fact. These changes are in the main confined to the projection room and the proscenium arch. Grandeur installations, contrary to popular opinion, present no problems which have not been met and solved in ordinary room installations.

There are no secrets about the Grandeur projector—or, at least, there should not be, insofar as the projectionist is concerned. Many projectionists are under the impression that Grandeur is similar to the so-called magnascope, which, as its name implies, is merely magnification. Grandeur is *not* magnification, but succeeds in giving a greater scope with more perspective to the picture. Projection problems are the same with Grandeur as with standard equipment, except, of course, the necessity for increased care and watchfulness requisite of any new development. This fact has been set forth previously in these columns by James J. Finn.

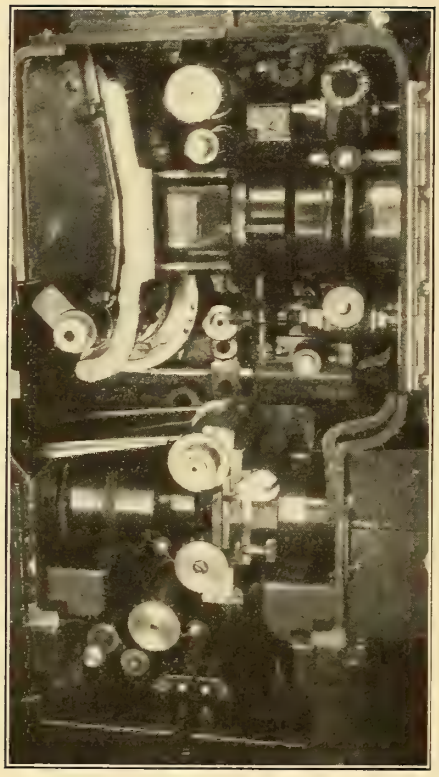
Grandeur film is 70 millimeters wide, which is twice the size of standard film. The photographic size is 1.890 x .901. The width of the sound track is 240 mills. Grandeur film magazines accommodate a 16 inch reel which holds 2,000 feet of film. Additional rewinds and film storage cabinets are necessary with Grandeur installations.



Fox Carthay Circle (L. A.), projection room. The installation, which includes three Grandeur and two standard projectors, was supervised by R. H. McCullough

Grandeur Mechanism

Grandeur projector mechanism is similar to that of the new Super Simplex, which has been described in detail in these columns. The only exception is that Grandeur mechanism parts are of much heavier construction. The film trap and film gate on Grandeur is curved outward toward



Grandeur mechanism. Note how the film trap and film gate curves to the aperature, thus eliminating buckling. The reproducing mechanism is directly below the film gate

the aperture. The aperture plate is installed in a permanent manner. The projection aperture size is 1.768 x .885. The curving of the film trap and film gate eliminates the possibility of buckling, which would present serious difficulties otherwise. The film is held in a perfectly flat focal plane at the aperture at all times.

Projection Details

A revolving shutter is installed between the light source and aperture, which reduces the heat on the film considerably. It is necessary to use High Intensity lamps with 200 amperes at the projector arc. It is interesting to note that with this amount of illumination passing through the film, that the latter remains at almost the same temperature as before passing through the projector. The position and rotation of the revolving shutter creates a circulation of air at the aperture which assists in reducing the heat at this point. This is a notable engineering achievement.

With "Happy Days," first Grandeur picture, projector speed was ninety feet per minute. Each foot of film has thirteen frames, and the sprocket perforations are, of course, much wider than 35 millimeter film. The sound reproducing mechanism is similar to the present equipment, with the exception that the film passes from the intermittent sprocket to the sound mechanism over a roller instead of passing to a take-up sprocket and then to the sound mechanism. A hold-back sprocket is installed between the take-up magazine and the sound unit sprocket. This eliminates flutter, which is caused by uneven take-up reels. Flutter is eliminated with Grandeur sound reproducing mechanism.

The Grandeur projector must be threaded with extreme care and accuracy. A length of film, equal to 11½ frames, or 10⅝ inches between the center of the projector aperture and the center of the aperture in the reproducing mechanism, is necessary for perfect reproduction.

Optical System

The lens assembly and aperture used in the reproducing mechanism is of proportionate size to cover the width of the sound track. The reproducing lamp, or exciting lamp, is provided with a much wider filament than is used ordinarily. This lamp operates at 8 volts, 4 amperes. The width of the reproducing aperture is 220 mills. The light from the sound track is collected by a W. E. 2-A photo electric cell. The photo electric cell amplifier is not attached to the projector mechanism but is installed upon brackets near and in front of the p.e. cell compartment. Installation was made in this manner to eliminate vibration, which emanates in the projector and which on many occasions is carried through the entire reproducing system.

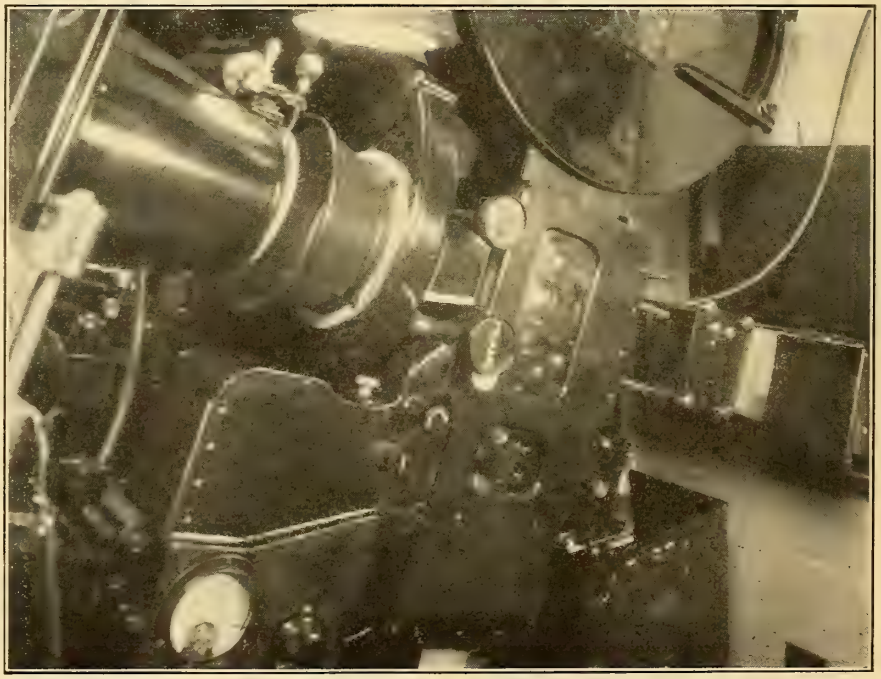
The Grandeur optical system is of the utmost importance because of the shape of the aperture. Both front and rear condensers have a cylindrical surface on the plano side to prevent light loss. These condenser lenses make it possible to secure a spot similar in proportion to the aperture size. The objective lenses used are of special design.

The projection angle at the Carthay Circle Theatre is 23 degrees. It was found necessary to install special glass prisms in front of each objective lens, so as to eliminate any vertical distortion. These prisms are adjustable, so that objects may be adjusted in height to eliminate such distortion. This theatre is 100 feet wide, yet every seat enables clear vision of the picture without distortion. The same type of screen—but larger, of course—is used with Grandeur as with other sound installations. The addition of an extra horn is necessary because of the greater picture width, and adjustment of these horns is also necessary to insure the proper illusion with respect to natural sound from the screen objects.

Screen Mounting

The Carthay Circle Theatre installation includes three Grandeur projectors and two standard projectors. The present standard-size picture is first shown and is followed by Grandeur. This enables the audience to draw a contrast between the respective sizes.

The screen is equipped with movable maskings which are manipulated from the side of the screen. The best illusion with Grandeur projection is secured by having the picture as close to the proscenium arch as possible, without affecting the patrons' view from the front rows, as the range of human vision cannot possibly take in so much width at such short range, Grandeur screen installations should be made as close to the floor as possible, to enhance the illusion of a stage presentation.



Side view of Grandeur projector mechanism. Note the prisms which are mounted in front of mechanism. The projection angle is 23 degrees and vertical distortion is eliminated by the use of these prisms

Vacuum Tube Amplifiers

A—Action of Audio Transformers

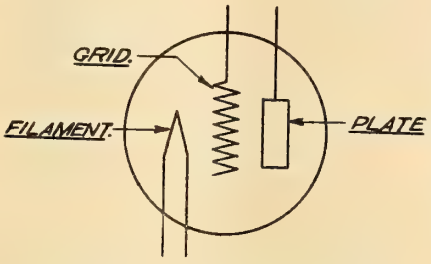
B—Operation of Amplifier Tubes

IT is a well-known fact that a steel bar magnet will attract other iron particles to it. If iron filings are sprinkled over the surface of a paper which is laid on top of a magnet, they will very definitely arrange themselves in a peculiar pattern. This pattern is known as the *magnetic field*, and seems to be made up of a number of lines extending in closed loops of ever increasing diameter from one pole of the magnet to the other pole of the magnet. The same effect occurs whenever an electric current flows in a wire, and there is a magnetic field around this wire. This action makes possible the action of any electro-magnetic instrument, such as telephones, telegraphs, meters—in fact, almost any electrical apparatus with which we are familiar today.

If the current in the wire is steady, the magnetic field about it will be steady; but if the current varies, the magnetic field about it will vary in strength in direct proportion to the change in the current, within certain limiting features which will not be discussed here. In effect, it seems that these magnetic lines start from the center of the wire and gradually expand as the current is increased. When the current decreases, the lines seem to contract towards the wire and disappear inside of it as the current dies out.

Transformer Action

The reverse of the above phenomenon is also true: that is, if a closed loop of wire be moved through a magnetic field, the magnetic field will produce in the wire a current of electricity. These two effects are directly responsible for the action of a transformer. If we mount two coils on the same iron core, and pass an alternating current through one of them, it will have built up around it a varying magnetic field. The loops will be opening and closing rapidly in accordance with the increase and decrease of current in the coil. This will produce a varying magnetic field through the second coil, thereby producing in it a current of electricity, if its terminals are connected together, either directly or through some external circuit.



Conventional vacuum tube symbol

An iron core is used so as to make it easier to pass the variations in magnetic flux from one coil to another. The amount of the electrical pressure or voltage obtainable from the second winding (secondary, as it is called), depends upon the number of turns of wire in it with respect to the number of turns of wire in the first coil (primary winding). If the winding from which we are drawing current, which is always called the secondary winding, has twice as many turns of wire upon it as the primary winding, the secondary voltage will be twice that of the primary voltage. If the secondary winding has three times as many turns as the primary, three times the voltage of the primary will be available at the secondary terminals, and so on.

If into the primary of a transformer an alternating current is fed, and the secondary of this transformer feeds into a three-element vacuum tube between grid and filament, and another transformer is connected in series with the plate circuit of that tube, it will be possible to get out of the secondary of the second transformer a much greater amount of power than was put into the first transformer. To understand how this is possible, we must return again to a consideration of the vacuum tube.

Operation of the Amplifier Tube

It will be remembered that one type of vacuum tube contains but two elements—the filament and the plate—and that it is possible to pass current through such a tube in but one direction, that is, from the plate to the filament. Fig. 1 (a); and Fig. 2. A special hook-up, using two of these tubes, makes it possible to change alternating current to a pulsating direct current. We do not get as much power available at the terminals of this rectifier as is put into it, however, because of the fact that the tube itself and its associated apparatus all have resistance, which cuts down the voltage available at the output.

Amplifier tubes used in sound picture work contain three elements—a filament, a grid, and a plate (Fig. 3.) The additional element, the grid, is placed in the space between the filament and the plate, and much nearer the filament than it is to the plate. The grid is composed of a mesh of fine wires with considerable space between them. Unlike the plate, the grid is kept negative at all times, so that no current may flow from it to the filament, or vice versa, for that matter. This negative grid tends to prevent electrons from being emitted from the filament to the plate, since it repels most of the electrons back towards the filament.

In order to balance this effect, the plate voltage is made rather high, so it still attracts a considerable number of the electrons past the grid in spite of its negative potential. However, if the negative charge on the grid is increased, the plate current will be decreased; and if the negative charge on the grid is decreased, the plate current will increase.

Thus, if an alternating current is impressed upon the grid of the vacuum tube, the plate current of that tube will vary in exact accordance with the variation in grid voltage. The advantage of this action is that the power in the plate circuit may be supplied from a battery or from some other source in quite large quantities, and the grid voltage is simply used to control the action of

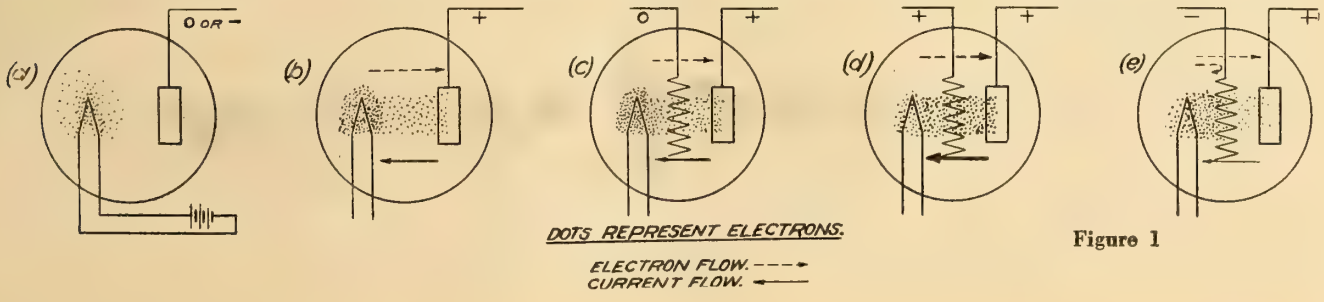


Figure 1

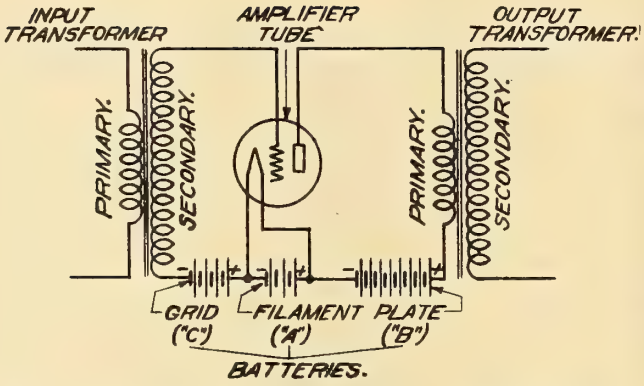


Fig. 4. Demonstrating use of transformers in amplifier circuit

this external power in the plate circuit.

The grid, being much nearer the filament than the plate, has a much greater control over the action of the electrons. Very small changes in the grid voltage, therefore, have a very great effect on the plate current. It is due to this fact that the tube in itself acts as an amplifier, since a small voltage can be fed into it, and a large amount of power be drawn from the plate circuit.

Grid Voltage

The addition of the grid in the vacuum tube has no effect whatever on the characteristic of the tube as a rectifier, until a voltage is applied to this grid. Fig 1 (c). If the grid is negative, Fig. 1 (e), it reduces the plate current; if positive, it increases it. Fig. 1 (d). When the grid voltage is varied from positive to zero, and down to negative, the change in the plate current is not uniform in proportion to the change in grid voltage. It is for that reason that the grid is kept negative all of the time in audio amplifiers, but not so negative as to prevent the flow of current entirely. Such a value of negative voltage is used that any variation we could get from the audio-transformer in the input circuit will not be sufficient to cause distortion in the output circuit.

An amplifier circuit using transformers is shown in Figure 4. The secondary of the input transformer has in it more turns of wire than are contained in the primary, which results in a step-up or increase, of the alternating current in the secondary with respect to that in the primary. This voltage is applied between the grid and filament of an amplifier tube, the action of which gives an increased amount of power in the primary of the output transformer. This increased power is then sent either to a loudspeaker for reproduction or into the grid circuit of another amplifier tube for further amplification.

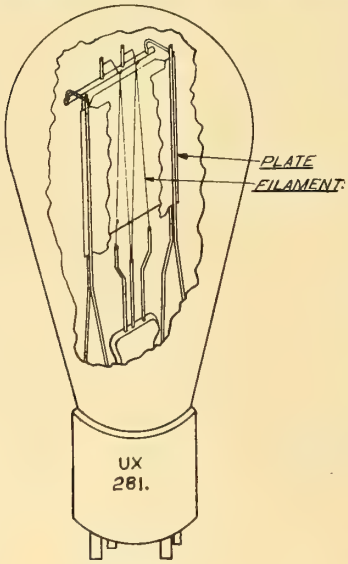


Figure 2

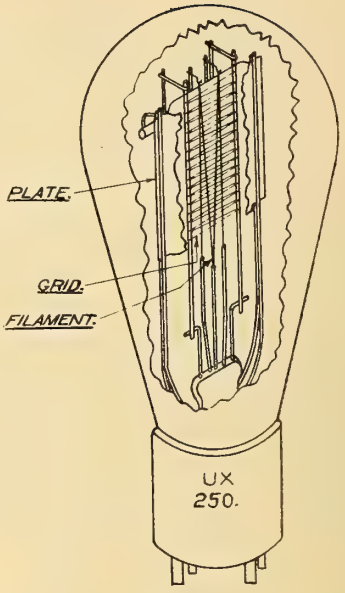


Figure 3

"Osiso" Projects Sound Wave Graph

SCIENCE has set its stamp of approval on the popular acclaim awarded to five of America's greatest musicians—Ernest Schelling, Vincent Lopez, Reinald Werrenrath, Countess Olga Albani, and Toscha Seidel—and has proved visually that the public ear for beautiful musical tones is in these cases perfectly accurate. At least, such was the purport of part of the lecture given recently by Dr. William Braid White, Director of Acoustic Research of the American Steel & Wire Company (subsidiary of the United States Steel Corporation) at the Science Forum of the New York Electrical Society.

Dr. White, who has been for the last two years studying the acoustics of piano wire, the visual analysis of noise and music, and the photographing of characteristic sound waves, demonstrated the results of his work to a jammed auditorium, not only by showing sound photographs on the stereopticon screen, but by actually having the five artists listed above appear on the stage and give visual examples of the sound waves created by their playing and singing. He did this by means of the projection osiso, an instrument developed recently by the Westinghouse Electric and Manufacturing Company for such work as he and other acoustic engineers are doing.

The Projection Osiso

The projection osiso is an apparatus which throws a straight line of light on a translucent screen. This line can be broken by the sound waves into moving patterns which, as they dance across the screen, indicate by their size, rapidity, and form the individual characteristics of each sound or group of sounds registered. The beam of a small carbon arc is so projected as to fall on a tiny mirror delicately supported upon knife edges and connected with the armature of an electro magnetic system. A small point of bright light is reflected from the mirror to a revolving drum with 16 mirror faces. These faces pick up the light point and reflect it on the translucent screen in a series of points moving horizontally, which because of the speed with which they move create the illusion of a straight line on the screen. The magnet is activated by a microphone circuit, with two stages of radio amplification, so that when sound impulses impinge upon the microphone diaphragm, these impulses are transformed into electric currents, causing the magnet to vibrate the mirror in time to the sound wave variations. The infinitesimal vibrations create a consequent up-and-down movement in the reflected pencil of light, which translates itself on the screen as a wave in the line—each sound or note producing a wave of different physical characteristics.

Noise as Scrambled Music

Using this method of picturing the complexities of sound waves, Dr. White discussed their curious and often confusing composition, calling attention to the discoveries of Professor Dayton C. Miller, pioneer of modern research in musical acoustics and pointing out that noise is nothing more than a group of pure musical tones discordantly or even harmoniously combined, but for too brief a time interval. In other words, if we

could analyze the composite noise of a vacuum cleaner into its various parts, we could probably track down some at least of the noise-producing elements—bearings, fan, etc.—and by elimination processes reduce this uproarious instrument of sanitation to a comparatively peaceful and doubtless also more efficient apparatus. The same method can probably be applied, in fact, to many of the present noisy manifestations of our machine age—"and civilization today," concluded the speaker, "will then stop driving itself crazy with its own clatter."

Interesting examples of the wrong and right use of the trained, pure-toned human voice were given by Reinald Werrenrath and Countess Albani. Mr. Werrenrath, in singing some sustained notes before the microphone, purposely changed his voice from its usual full rich tone, cutting out some of the lower frequencies; and then sang the same notes using his normal voice. The sound waves on the screen in the first case showed the sharper, more uneven, form of these notes; and in the latter case took on an even perfection of line apparently exactly expressive of the beauty of the voice itself. When Countess Albani sang, the great difference of the feminine voice from the masculine, due to the higher voice frequencies, was clearly portrayed on the screen by the wave track; but because of the richness of the trained tone, the unmusical high frequencies were eliminated, and sound waves of unusual perfection danced before the eyes of the delighted audience.

Jazz vs. Classical Pictures

Ernest Schelling played the piano with his usual brilliance, the sound waves of the classical music forming in a more or less irregular pattern on the osiso screen; and when Vincent Lopez, representing the jazz age, gave an example of his own fine ability, the curious, repeated regularity of certain jazz rhythms stood witness to the fundamental differences between the two schools of music.

Toscha Seidel, on the violin, made the osiso form entirely new and unusually beautiful sound patterns, the visual effects of this instrument in the hands of a master again bringing out the unrecognized possibilities for a more intelligent study of music and noise, opening new fields in working toward perfection in the former, reduction in the latter case. Other instruments demonstrated included an oboe, clarinet, saxophone, and horn—each producing a different characteristic pattern.

Sound Divided Into Component Parts

Dr. White showed the methods of analyzing sound by a well-known but striking experiment. Fastening one end of a string to an electrically vibrated tuning fork, he took the other end, some six feet away, and held the string at different degrees of tension. The string broke up into one, two, three, four, or more standing waves, according to the tension. He then explained that every musical tone can be analyzed into a fundamental vibration (vibration of the whole), and then into two parts, three parts, etc., these latter being the harmonics or "side notes" of the various instruments, voices, and sounds depend on how many of these harmonic vibrations are present in any case. The oboe, for instance, shows a different characteristic note from the clarinet because it has higher harmonics; the trumpet higher and therefore more discordant harmonics than the horn, etc.

Errata



Harry Rubin

As a result of an oversight on the part of a proofreader, the name of Harry Rubin, Director of Projection for Publix Theatres, was omitted from the listing of the board of editors which appeared in the March issue.

We regret this oversight, and we hasten to add that Mr. Rubin is still an active member of this paper's editorial staff—so much so, in fact, that he will soon contribute the first of a series of articles on projection based on his experience as director of projection for one of America's foremost theatre chains.—The Editor.

W. E. Installs Its 5000th Sound Apparatus

The 5000th Western Electric Sound System installation has been completed.

The first Western Electric sound reproducing equipment was installed in Warner's Theatre, New York, for the opening of the first sound picture, John Barrymore in "Don Juan" on Aug. 6, 1926. This was at a time when the industry viewed the outlook for sound pictures with sour skepticism. By the end of 1926 only 15 theatres had been equipped by the Vitaphone Corporation which, at that time, was distributing the Western Electric Sound System.

Warner Brothers had taken out a license to record by the Western Electric Sound System specializing in the disc method, and Fox had become a licensee specializing in the sound on film method. In the spring of 1927 practically all the large producers, Paramount Famous Lasky, First National, Metro-Goldwyn, Universal, United Artists, and Columbia Pictures were licensed to record talking pictures by the Western Electric System.

1,046 Installed in 1928

The number of installations at the end of 1927 was held to 157 only because there had not been sufficient time to develop the trained man power and manufacturing facilities to meet the sudden, sensational demand for the product of this new art and do it in a manner that would be consistent with high quality. During all of 1928 the Western Electric factory and men were working at top speed to supply theatre needs so that by the end of the year the 1,000 mark had been passed. The exact number of installations on Dec. 31, 1928, was 1,046.

Throughout 1929 installations continued at a steady rate and the total, by the end of the year, was 4,354. It was predicted then, that the passing of the 5,000 mark would be a matter of weeks only.

Projection Service Log

PROJECTOR NO. 1				PROJECTOR NO. 2			
Gear Box Greased	Motor Cups Filled	Turntable Gear Pot Oiled	General Tube Inspection	Gear Box Greased	Motor Cups Filled	Turntable Gear Pot Oiled	General Tube Inspection
Date	Date	Date	Date	Date	Date	Date	Date

Service log used in Fox N. Y. City theatre. Submitted by S. Wein

Principles of Rectification

THE usual method of rectifying or changing A. C. to D. C. is by means of a rectifier unit. This is also necessary with A. C. supply for battery charging, since batteries cannot be charged with the to-and-fro cycle pulsations of alternating current but must have a one-way charge source. The prime requisite in any rectifying element or charger is the gas-valve or dry-element rectifier, whichever may be used. The gas valve in practice so far has been found the most useful and easiest to handle.

The action of any rectifying element, whether bulb or dry element, is this: Certain metallic compounds when introduced into certain gases have an exceedingly low resistance to current passing through them in one direction, but set up an exceedingly high resistance to its flow in the opposite path. One or another of these, introduced into a sealed glass tube or bulb in which is a certain quantity of the proper gas, forms the positive electrode of a circuit which takes its energy from a transformer.

The transformer is to step-up the voltage so as to reach the required pressure with the high percentage of voltage drop taking place in the rectifier tube. The second electrode is so inter-connected with the circuit of the power-using device that current which is passed will flow through such outlet, do its work and return to the negative end of the transformer secondary.

It may be disputed that there is no positive and negative *end* to a circuit which is transforming A. C. However, although the primary winding has its ends alternately positive and negative with the cycle changes of the current flowing through it from the line, the action of the rectifier itself makes the secondary a one-way, or artificially one-direction, medium.

Supposing the A. C. to induce a response in the secondary of the transformer in part of the cycle where the conditions are as stated—that is, when the rectifying element within the tube is actually the positive of that direction of current flow. Then, due to its action as already declared, it will meet with practically no resistance and the current will either use the gas itself as a path or, where an artificial path is created with an electron-release from a heated filament, the current will flow over the path, through the circuit (doing its useful work), and back to the (then) negative of the transformer secondary.

But, as is the case with alternating current, immediately the primary current changes direction after falling away from the voltage peak of the first direction of flow. The induced current in the transformer secondary winding tends then also to flow in the reverse direction, but despite the electron-path or gas-path, there is automatically opposed to it the resistance action of the rectifying element, and this resistance instantaneously becomes so high that no measurable current flows, possibly none at all.

Thus there is no current flow through the circuit in that direction; the line, in effect, is "dead" to that half of the cycle, so that the rectifier has performed the valve-action of shutting off current flow in a direction reverse to that desired. Immediately again the primary current changes back to the first direction of flow, the induced current meets no opposition from the rectifier which passes the current through the circuit; instantly a reversal occurs and again the opposition stops off the reversal of flow, and this action continues (on-and-off action), with the recurring pulsations of the current.

The valve is acting, in that case, as a half-wave rectifier, cutting away one half, allowing the other half of each cycle to pass.

Full-Wave Rectifier

It can be seen at once that by properly wiring up two such rectifier valves so that one is the positive for the flow in one direction and the other for current flow in reverse, a full-wave rectifier is achieved and both halves of each cycle can be passed (through proper wiring), into the useful work done through the circuit, and brought back to a negative which, for such a case, must necessarily be tapped in at the central point of the secondary transformer windings, which is thus the negative for each end when that end is a positive.

Valves are also made which are in themselves fullwave rectifiers, and in these there are two electrodes of the metallic compound, to each of which an end of the transformer is attached. The current from each in turn passes through either the gas- or electron-path into a third connection which is integral with the circuit through which work is to be done. In such case the center tap of the secondary is again the negative alternately for each end of transformer secondary, and is the return wire of the circuit.

Dry-Element Rectifiers

In dry-element rectifiers two metals or compounds are held pressed together and they are of such electrical properties that they become conductors to current flow in one direction and high resistances to it in the reverse of flow. Also, in certain wet-cell rectifiers the same action is secured by making a metallic plate in a suitable solution pass current through the solution to the other electrode and, on cycle reversal, form upon itself a sort of film of the solution, which, in that case, acts as the resistance and blocks current flow in reverse.

Whatever the means, the action is always the same. It is easy to see that the delivered current is, in its unmodified state, a series of peaks of voltage with intervals of lowering and increasing pressure. Other elements of the assembly are introduced to smooth out this jagged current into as closely as possible a smooth, constant pressure form. Choke coils act to produce higher resistance as higher voltages flow through them, and to oppose less inductively-produced resistance to lower pressures, so that they work to iron out, as it were, the heavy changes. Condensers or reservoirs of large capacity also act to check the current pulsations.

For battery charging, the ripples do not matter much so long as current flow is in one direction only. But for other uses current must be thoroughly smoothed out. Where a grid allows plate current to pass in a definite ratio to grid change of potential, it is easy to realize that a sudden decrease or increase of plate voltage due to current fluctuation would destroy the perfect valve action and consequently injure amplification or other action.

Protests Aperture Practice

Editor, Motion Picture Projectionist:

As a subscriber to the *Motion Picture Projectionist*, I would like to submit the following: Since the advent of sound the projectionist has another problem that must be overcome, and that is the projection aperture for sound-on-film. The present dual lens system does not answer the purpose; it is a makeshift, a second choice, and should be remedied.

A majority of the leading theatres are now using the dual lens system, with a rectangular picture for both the sound-on-film and disc picture, but with disgusting results when a sound-on-film picture is thrown on the screen.

The heads of characters, feet, titles, and other portions of the picture originally intended to reach the screen, are cut off by the proportional aperture, and they are only brought into the picture by continual framing by a very alert projectionist, and then the results are not just what is wanted. In the hands of a shiftless projectionist it is a crime.

Our program here is 100 per cent sound-on-film but we have gone back to the original sound-on-film aperture with the square picture on the screen (centered and masked in equally on both sides), as the lesser of the two evils.

It seems to me that it is high time that the producers and cameramen are asked to correct this fault and I think that the *Motion Picture Projectionist* should take the matter up with them. Yours for better projection.—GEORGE J. KAMM, L. U. 682, Lancaster, Pa.

New Advances in the Art

Photo-Electric Cell and Amplifier Unit

A PHOTO-ELECTRIC cell with an amplifier is now sold as a unit by the Westinghouse Electric and Manufacturing Company. The photo-electric cell, often called the "electric eye," is a light-sensitive device. When light falls upon it, voltage having been applied to the cathode, a current passes by means of electron emission from the cathode to the anode. This current is very small, but, when amplified, operates commercial relays.

For some applications, complete apparatus has been developed and can be supplied as a unit; but for most applications where no standard apparatus is available, the photo-electric cell with its amplifier is sold as a unit to be applied by the customer.

Amplifier Unit

The amplifier unit, shown in the illustration, consists of a die-cast aluminum box in which are mounted the necessary coupling devices. The top, which is a Micarta panel, is provided with two four-prong bases for mounting the photo-electric cell and the amplifier tube. All of the wiring is concealed, connections being made to binding posts on the top panel. The unit is dust-proof and moisture-proof. The short connections in the unit make possible a very high speed response—between .0001 and .001 seconds.

Although four prongs are supplied in the photo cell, for mounting in a standard four-prong base, only two are connected—the anode and cathode prongs. The cathode plate or cell window, which is coated with Caesium, the light sensitive material, faces the two large prongs.

Does Variety of Work

Industrial engineers and experimenters find this device applicable to tasks now requiring tiresome watching by the human eye. Some of the many applications are: sorting materials, according to color, size, and shape; counting items, where mass production requires speed; initiating operations, such as ringing an alarm on a paper machine when a break occurs in the paper; lighting control, for turning on and off artificial lights according to the intensity of the natural light; position indicator, for showing positions of doors, moving cars, etc.; light intensity meter, for measuring intensity meter, for measuring intensity of light for photography; scanning material, to detect flaws or defects; ultra-violet ray meter, for recording the intensity of ultra-violet light; instrument for ascertaining fog height, used with a captive balloon in determining fog height necessary for safe airplane height.



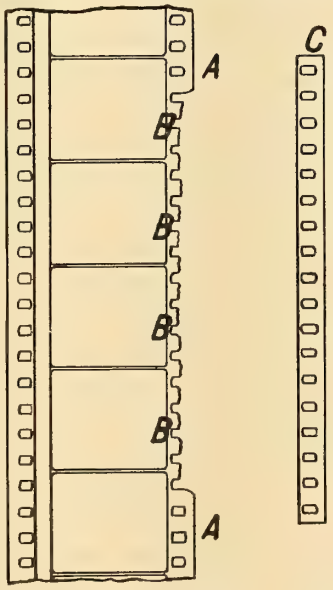
Westinghouse photo-electric cell and amplifier unit

Unique Film Patch

By R. A. GODFREY,

Secretary Local 507, Macon, Ga.

Here is a little kink that I have employed with much success that might prove of interest to projectionists. With this kink the projectionist does not cut the film and insert blank



leader when the sprocket holes are torn.

Referring to the accompanying illustration: Take a good piece of film and cut a strip (C), so that it will lap one sprocket hole at the top and bottom and will lap a little along B. This operation requires care, but if the projectionist is careful a very good job can be made of it, and there will be no necessity for putting into the reel an unsightly black strip of film.

I have patched a great many pictures in this fashion. The patch is hardly noticeable when running through the projector, and if it is properly made, there need be no concern about the patch ripping open. In fact, it has been my experience that this sort of patch is even better than the conventional splice, both for efficiency and durability.

Show Many New Uses for Ultra Violet Ray

An invisible or ultra violet ray light for the protection of valuables, or burglar alarm, science's latest contribution to the law enforcement authorities, was demonstrated by James L. McCoy, Research Engineer of the Westinghouse Lamp Company, before the members of the New York Section of the Illuminating Engineering Society at a meeting held in the auditorium of the Westinghouse Lighting Institute in New York City recently.

To show his confidence in the ability of this new discovery, Mr. McCoy placed a fifty-dollar bill in the safe used in his demonstration, turned the combination off, closed the door, and informed the audience which included representatives of the Police Department of the City of New York, that anyone who could get the money without sounding the alarm was welcome to it.

Tear Gas Barrage

It is predicted that with the invisible ultra violet rays, it will be possible for jewelers, bankers and other custodians of valuable properties, to greatly add to the security of their charges. These ultra violet rays are invisible both in lighted and darkened rooms and therefore it is impossible for the intruder to move about without being detected, as the rays can be placed at various angles in the room. They could be made to asphyxiate a victim with a barrage of tear gas, set off silent alarms, etc. In other words, the burglar is put completely at the mercy of this ingenious device.

In demonstrating the invisible light as a burglar alarm, a five-foot safe was placed in the center of the stage facing the audience. Two ordinary tables about waisthigh were placed twelve feet apart; on one was the light source, and on the other were two types of cells; one cell sensitive to visible and infra red light, and the other responsive only to the invisible rays of ultra violet light.

Impossible to Fool Rays

The invisible rays were projected just across the front or door of the safe at the combination, so that any attempt to touch or open the door would immediately sound the alarm.

There were three demonstrations of this burglar alarm system. In

explaining these demonstrations, Mr. McCoy said his reason for first sending the visible light message was to show how an educated burglar might fool the device by turning the beam of his ash light on the photoelectric cell or "electric eye" while he was interrupting the original beam to open the safe. The next message was to fool the infra red cell by using a mazda light, the ordinary light used for general illumination, shining on the cell while he was interrupting the beam of the infra red light, as there is sufficient infra red light produced in the mazda lamp to operate the cell. The third was to show how impossible it would be for the burglar to open the safe due to his inability to produce the invisible ultra violet light.

The light sensitive apparatus used consisted of a photoelectric cell in turn connected to a starting anode tube which was tuned to operate the bell used to give the alarm, and turn on the auditorium lights.

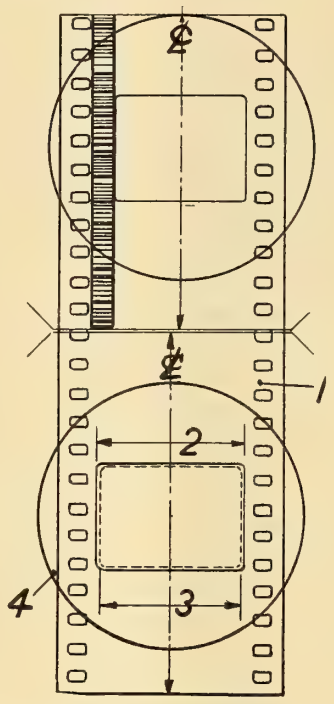
When the beam of light was interrupted by the burglar attempting to open the safe, the light falling on the photoelectric cell was interrupted, thus in turn causing the anode tube to glow. When this occurred, it energized the alarm relay. This starting anode tube continued to glow, thus sounding a gong which continued to ring until a concealed switch was manually operated to turn the alarm off. This function is very desirable from an alarm standpoint.

"Electric Eye"

J. V. Breisky, research engineer of the Westinghouse Electric and Manufacturing Company's laboratories at East Pittsburgh, demonstrated other devices developed by the Westinghouse Company where the photoelectric cell or "electric eye" is used. Everyone entering the room was automatically counted as he crossed a beam of light which was thrown across the doorway. The shadow of a passing body caused the "electric eye" to communicate with a counting machine. An automatic sorting machine was able to detect differences in the appearance of packages. A related device operated a fire extinguisher as soon as a whiff of smoke appeared. The ingenuity of modern research engineers is bringing a quick solution to many difficult problems. It is interesting to observe how many uses have already been found for the practical application of a machine which can see.

GoldE Mount Requires Only One Lens

A new optical mount for sound and silent picture projection has been developed and is now being marketed by the GoldE Manufacturing Co. of Chicago. This new mount is known as the GoldE Uni-Lens Mount and may be had at all National Theatre Supply Co. branches. Only one lens—



that lens now in use in any projection room—is necessary with this new mount. It requires no changing, no prisms and is guaranteed to give perfect focus with both silent and sound picture presentations.

The accompanying drawing presents details of the aperture size with regard to the use of the GoldE mount: 1. Center line for standard and disc projection. 2. Standard aperture width. 3. Proportionate aperture centered for projection, according to the new standard recently adopted by the S. M. P. E. 4. Masking radius of mount, showing an inappreciable cut-off on top, bottom, and sides, obtaining full width, according to ground glass camera markings.

Only One Lens Needed

The use of only one lens—the standard house lens—does not necessitate any changing operation which would result in loss of time, inconvenience and probable interruption. One touch of a lever on the mount is all that is necessary to prepare for either sound or silent picture projection. The GoldE lens Mount is guaranteed to give perfect focus for either type presentation, and will introduce no distortion.

Because of its instantaneous action, the GoldE mount may be used to great advantage on all combination sound, silent and disc presentations. The projectionist is assured of positive control at all times. The mount requires no extra appliances.

Gleanings From the Mail Bag

Editor, M. P. Projectionist.

Sir:—I feel some comment is necessary at this time on the practice of film exchanges, particularly here in the Northwest, of adding blank film to sound-on-film prints. We have been having much trouble in this section of the country as a result of the exchanges using the same print for sound-on-film as for disc shows. Anyone who knows anything at all about sound reproduction will agree that this practice is all wrong, and we projectionists are the beneficiaries of all sorts of trouble therefrom.

The exchanges add blank film with white frame lines, thus causing a popping noise when passing the exciting lamp. One or two frames would pose no difficult problem, but some exchanges of which I have personal knowledge add any number of frames up to 18.

Lectures—and More Lectures

This situation has its humorous side—but not for projectionists. When sound pictures arrived we projectionists were patted on the back, told to do this and not to do the other thing, were asked to cooperate and were assured all necessary aid in putting on a good show would be forthcoming. If there is a projectionist in this country who can put on a decent show in the face of the practice cited above, I should like to meet him. It is all very lovely and convenient for the exchanges, but what are we fellows supposed to do when in the middle of a song or dialogue there suddenly hoves into view about ten feet of blank leader?

Periodically we are lectured and hectored about our handling of film—"do this, don't do that." I don't believe any projectionist needs more than an "even break" in the matter of decent film and fair equipment to put on a good show, but putting on a good show with the type of film one receives from an exchange these days is impossible. We can't do a thing to remedy such conditions, but it is not unlikely that you may be able to forward this complaint to persons in authority who will direct that the practice be ended.—CHARLES B. LUDING, St. Paul, Minn.

Perth Amboy School

Local Union 356 of Perth Amboy, N. J., is sponsoring a sound projection school for its members similar to those societies which are now being inaugurated in many Locals throughout the country. A permanent meeting hall for this educational society has been secured where meetings are held weekly.

It is the aim of the directors of the school to present each week to the members an expert in some particular phase of the sound picture art who will describe in detail the components, purpose and function of his specialty. Thus far several meetings have been held, and Local 356 members are enthusiastic about the results obtained.

Everyday Science

Amazing Demonstration of 'Manufactured' Lightning

MILLION-VOLT bolts of lightning struck repeatedly in East Pittsburgh recently, although the United States Weather Bureau reported no such atmospheric disturbances. The lightning crashed harmlessly, however, and proved instructive to approximately 400 members of the American Institute of Electrical Engineers and the Engineers Society of Western Pennsylvania. The lightning was artificial and it came from one of the world's first 1,000,000-volt portable surge generators, built and used by the Westinghouse Electric and Manufacturing Company for studying the effect of lightning on transmission lines.

Tests Transmission Lines

This portable lightning generator, together with a portable lightning laboratory housing a cathode ray oscillograph station, has been in operation on several transmission lines during the past several months, and extremely beneficial results have been accomplished in characterizing the performance on lines struck by heavy surges.

Located in the yard between two buildings in East Pittsburgh, the generator crashed its bolts through the air several times for the enlightenment of the visiting engineers. Members of the Westinghouse staff explained the operation of the equipment of the testing devices and told of the new porous disc lightning arrester which has recently been developed by the Company.

Electrical Tricks

First in the domonstration a million-volt surge was made to jump across a huge suspension insulator and the effect noted. Then one of the new autovalve lightning arresters was placed in parallel with the insulator and the generator functioned again. The arrester absorbed the total surge, preventing the insulator flashover.

A spectacular stunt was the sending of a surge along a miniature transmission line showing the effect of corona discharge. The final demonstration was the sending of a lightning surge into a 40-foot length of fine wire, completely burning the wire to nothing.

Taking Pictures with Clock

Down in Maryland, a scientist who specializes in taking motion pictures of plants and insects has invented a mechanism whereby he attaches an eight-day clock which operates with the camera. In practice the clock is attached to a small motor and crank shaft, and owing to plants growing slowly, the clock is set to take pictures at given intervals during the eight days the clock runs. Some wonderful results have been obtained through this method.

Modern Scientific Wonders

By means of vacuum tubes, and usually by their use in radio, wonders are accomplished, to the lay viewpoint, although engineers dispassionately discuss such things only as so much work done. Battleships piloted in their courses, with nobody aboard, an electrical man that obeys signals given in light, a throat utters sounds that drives an automobile that is 400 miles away, stations all over the world listen to a program of education radiated on a short wave from New York, a hand waved over a box makes the Theremin play music that sounds something like a bass viol.

When Wonders Cease

When the novelty wears off, the wonder ceases, but the work performed becomes more widespread and the invention more useful and valuable. As soon as we extract the wonder from a feat we inject utilitarianism. When wonders cease to be wonders, it means the world has put them to work.

Regular Television Schedule

Two stations of the Jenkins Television Corporation are now in operation. They are W2XCD, Passaic, N. J., 500 watts 1604 kc. (187 meters), and W2XCR, Jersey City, N. J., 1000 watts, 2150 kc. (140 meters). The hours of operation are:

W2XCD 8 to 10 P. M. daily except Sunday (E. S. T.).

W2XCR 8 to 10 P. M. daily except Sunday (E. S. T.).

At present the Passaic station is sending out the sound accompaniment for the shadowgraphs transmitted on the 140-meter wavelength by the Jersey City station.

Radio Waves Penetrate 300 Feet of Rock

Radio waves from a broadcasting station 200 miles away have been found, in experiment conducted by the United States Bureau of Mines and the Geological Survey of Canada, to penetrate 300 feet of rock, A. S. Eve of Montreal, asserted in a paper read at the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York City. One object of the experiment was to determine the value of such waves in prospecting for underground ore bodies.

Other tests indicated, Mr. Eve declared, that electro-magnetic waves were passing through 900 feet of rock. As a result of these experiments, which were pioneer in character, it was concluded, says the *New York Sun*, that Morse signals could be sent readily to large areas of a mine if those underground were supplied with receiving coils and headphones.

Color Patents Lead

Fifty-two patents of the 256 that dealt with film devices granted in Great Britain during 1928-29 specified color in some form or other. 57 related to sound while 21 were issued regarding stereoscopic processes.

March an Important Month in Telephone History

Alexander Graham Bell, inventor of the telephone, was born March 3, 1847.

The first complete sentence was transmitted over a wire, by telephone, on March 10, 1876.

National Bell Telephone Company, chartered under the laws of Massachusetts to supersede the two companies then in existence, the New England Telephone Company and the Bell Telephone, March, 1879.

First telephone exchange opened in New Orleans, La., March 15, 1879.

Boston-New York long distance telephone line opened March 27, 1884.

Bell loud speaker used at inauguration of President Harding; 125,000 people heard address, March 4, 1921.

Complete radio telephone circuit between New Canaan, Conn., and S. S. America, 400 miles at sea, demonstrated by Bell System engineers, March 5, 1922.

The first complete two-way communication by radio-telephony between the United States and Europe was maintained for the first time during the month of March, 1926.

Electric Device Makes Ton of Coal Do More

The British steamship, City of Hongkong, has just completed a round trip from Liverpool to India and return, it is announced by her owners, with a saving of over one-fourth of the amount of coal previously needed, thanks to a new electric apparatus which the inventor claims is destined to revolutionize ocean transportation for all except the largest and fastest vessels.

The essential part of the apparatus, invented by Mr. James Scott, of Liverpool, is a special steam turbine which takes the exhaust steam from the ordinary engines of the ves-

sel when this steam is ready to be thrown away up the smokestack and uses it to produce electricity. The energy thus saved in the form of electric current then drives a motor connected to the propeller shaft of the steamship. The power thus applied is too small to drive the vessel or to be of important use by itself but aids the ordinary engines, applies just that much extra power to the propeller and enables the vessel to maintain its scheduled speed, the recent test on the City of Hongkong is said to have proved, with the expenditure of from 25 per cent to 27 per cent less coal than would have been burned had the waste steam been thrown away.

Competent Engineers in Demand

Corporations engaged in perfecting the talking picture, trans-Atlantic telephony and radio telegraphy are demanding the services of more young men with advanced scientific training than technical schools are supplying, according to Professor Walter I. Schlichter of the department of electrical engineering, Columbia University.

Professor Schlichter declares that every able electrical engineer graduate at Columbia this year will have an opportunity to commence important research work in the laboratories of from four to seven large corporations. Older engineers with years of practical experience, he asserted, are far less competent to cope with the problems encountered in research laboratories today than the graduate of 1929 with special training in advanced fields.

"The talking moving picture is similar to the radio in principle," said Prof. Schlichter, "involving as it does the sound features of the radio and the use of the photoelectric cell. The ultimate development of the quality of the voice in the sound picture will depend upon the activities of young men now working in this field."

Subway Air Cools Theatres and Offices

Forty feet below the stores in Chicago there exists a very extensive system of freight tunnels, which handle a great volume of merchandise between railroad terminals, docks and commercial houses—thus relieving the streets in the Loop District of 5,000 motor truck movements per day. The Chicago Tunnel Terminal Corporation, which owns this little-known subway, operates 62 miles of tunnels, six feet by seven and one-half feet, equipped with two-foot gauge tracks. The rolling-stock consists of 3,300 cars of four-ton capacity each, and 150 electric locomotives. During every 24 hours, about 300 trains of from 10 to 15 cars each are run.

An odd by-product of this system is the use of the air contained in these tunnels. Forty feet below the street, the temperature remains practically constant at 55 degrees throughout the year. The cool, pure, dry air is drawn up through shafts and used to ventilate and cool many buildings and theatres in the Loop District.

New Color Attachment

A new attachment for the taking of still and motion pictures in natural color is claimed by an inventor out in Pittsburgh. This attachment fits on the lens and it is not necessary to use panchromatic film or any special developing solutions.

Photographing the Eye

In one of the leading German medical universities, a doctor has invented a camera with which he is able to photograph the interior of the human eyes as they function. The camera has been constructed so it practically makes action pictures and uses the X-ray lamp as the light source.

"One Time" Clock for World

A proposal which will provide universal accurate time throughout the whole world by radio has been advanced as a solution for the varying time systems in different countries with inaccuracies creeping into each system.

The proposal provides for a central astronomical observatory from which a master electric clock will send time ticks instantaneously by radio to all countries, giving a single accurate time. This is a further development of the present system, followed separately by various countries, of setting clocks by radio and telegraph from a national observatory, which results in differences and discrepancies creeping in.

In the plan proposed, television devices would be used to synchronize all clocks with a master timepiece, and with this system in operation the world's clocks need never be any more than one one-hundred-thousandths of a second apart.

The Labor Injunction

THE history of the labor injunction in action puts some matters beyond question. In large part, dissatisfaction and resentment are caused, first by the refusal of courts to recognize that breaches of the peace may be redressed through criminal prosecution and civil action for damages, and second, by the expansion of a simple, judicial device to an enveloping code of prohibited conduct, absorbing, en masse, executive and police functions and affecting the livelihood, and even lives, of multitudes. Especially those zealous for the unimpaired prestige of our courts have observed how the administration of law by decrees which through vast and vague phrases surmount law, undermines the esteem of courts upon which our reign of law depends. Not government, but "government by injunction" characterized by the consequences of a criminal prosecution without its safeguards, has been challenged.—Frankfurter and Greene in *The Labor Injunction.*

Sun-Cure Impossible Without Certain Amount of Work

Work and sunlight go together, says the famous sun-cure expert, Dr. Auguste Rollier, of Leysin, Switzerland, to cure some of the body's most dangerous diseases, like the dreaded tuberculosis of the bones. Therefore Dr. Rollier and the philanthropists who are aiding his work are building on the sunlit mountain slopes at Leysin a "factory clinic" where even patients who are bed-ridden will be able to work at some interesting and money-making trade while their diseased bodies are exposed to the curative powers of Alpine sunlight.

Special bedsteads have been devised in which patients lie naked in the sunlight but can still work comfortably with their hands. A narrow portion of the mattress can be tilted upward at one end, for example, like a pillow underneath the chest of a patient lying prone, so that chest and chin are supported but the arms left free to use a typewriter, a sewing machine or other tools on a table at the head of the bed.

Power of Sunlight

The effect of sunlight on a bed-ridden invalid is soon evidenced, Dr. Rollier reports, by a tendency of the wasted muscle fibers to fill out and regain their strength, something which he ascribes to improvement in the circulation of blood. Thus muscular strength enough for work is soon restored by the sun and to be working then aids the curative effects of sunlight both on body and mind.

Articles made by patients who are not well-to-do are sold for the patient's benefit. Funds are now being raised for additional sun-and-work facilities.

American Machines Popular

Projection machines exported to foreign countries during 1929 totaled 4,300, advices to the M. P. Division of the Dept. of Commerce state. Of this figure 1,989 were of standard gauge (35 mm) with a value of $592,-319 while 2,311 projectors of less than 35 mm with a value of $212,947 were exported during the period.



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What Television is—the apparatus used—technique — problems — operation of equipment—Television with sound accompaniment—all in one book with splendid schematic illustrations which are traced out in detail.

ROXY Says:

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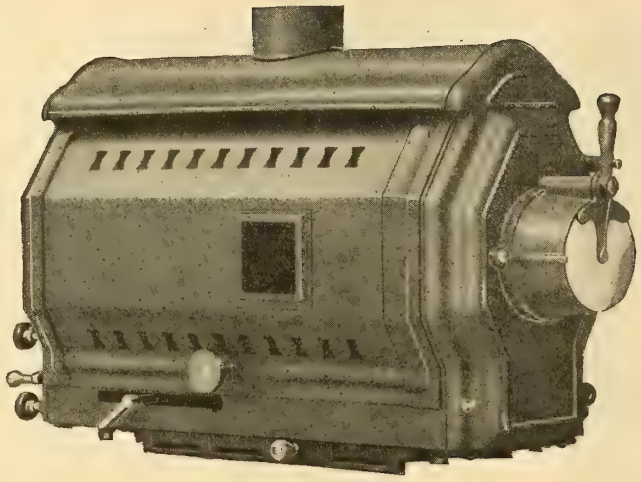
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REFLECTOR ARC LAMP

A SUPERIOR low intensity reflector arc lamp of rugged construction that gives the owner the utmost in performance at a minimum expense.

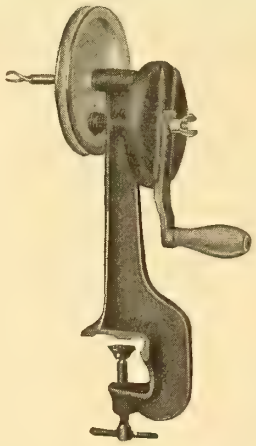
New conveniences—new flexibility—modern design and precision workmanship make the Brenkert Reflector Arc Lamp most efficient and accurate.

This lamp is guaranteed by Brenkert, one of the oldest and largest manufacturers of theatrical light projection equipment in the industry.

Write for special literature and name of nearest dealer.

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Complete your sound equipment with a

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Rewind Pulley

Takes the place of space collar on Reel shaft—Crank is not Removed

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Unique Engineering Service by De Forest Sound Clinic

AN innovation in the merchandising of motion picture theatre equipment is now being sponsored by General Talking Picture Equipment Corp., in the establishment by them of the De Forest Sound Clinic which has been organized to enable all theatres to avail themselves of a unique service for sound picture apparatus. Briefly stated, this new De Forest Clinic will bring to any theatre which at present is experiencing trouble with its sound picture apparatus, a complete engineering service which will be in the nature of a survey of existing difficulties and definite recommendations for subsequent procedure which will bring the equipment up to a point of efficiency on a par with the best and costliest sound systems.

A typical illustration of the work to be done by the De Forest Sound Clinic is as follows: Assuming that a certain theatre has installed complete reproducing apparatus which, while efficient in some respects, is not delivering wholly satisfactory results. Assuming that the speaker units, amplifiers, and disc equipment are satisfactory, the system would be prevented from functioning efficiently by, for example, a faulty sound head, which unit is the cause of the bulk of reproducer troubles.

Single Unit Replacement

Under these circumstances, De Forest Sound Clinic engineers would make a survey of the theatre as a whole and an inspection of the entire sound equipment. Those units of the existing apparatus which would serve in future would be retained, while the defective unit or units would be replaced by standard and guaranteed General Talking Picture Co. units. In this way any theatre, irrespective of present type equipment, would be enabled to present perfect sound reproduction at a very minimum expense.

To cite the particular case mentioned above, the installation of a new General Talking Picture sound head would be made, after which all component parts of the apparatus would be checked and balanced so as to secure perfect results. This same procedure would be followed in all cases, whether the trouble be due to amplifiers, disc equipment, sound heads, or speakers. Nothing will be installed except the particular units which are demonstrated to be defective by the engineers' survey.

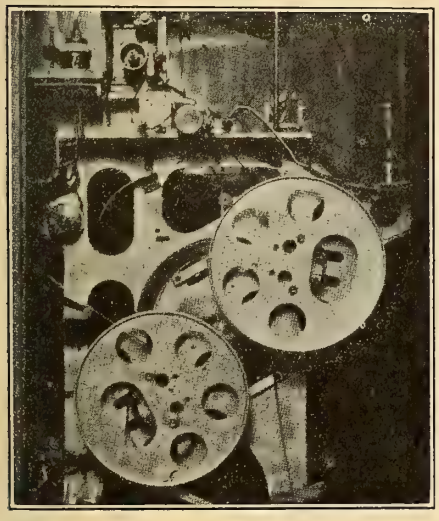
Economic Considerations

General Talking Picture Corp. considers this plan for the De Forest Sound Clinic to offer to hundreds of exhibitors who are now concerned about poor sound reproduction, a chance to attain 100 per cent efficiency at a minimum expense. It is generally known that many theatres in which are installed inferior sound

Continuous Projection

(From *The Bioscope*)
London, England

THERE have been some hundreds of attempts to devise apparatus that will re-wind the film on the second spool so that it is at once ready for re-projection. The modern demand for automatic projectors for industrial and educational purposes has made the problem acute. Most of the devices to date have shown some disadvantages, such as "creeping," but an ingenious arrangement, now being marketed by Continuous Projectors, Ltd., appears to have overcome all difficulties in a way at once simple and effective. We saw the projector demonstrated last week, and it operated without a hitch, with normal 35 mm. stock, as well as sub-standard.



Mechanism of continuous projector which has just been shown in England

Endless Band Principle

Although the method is simple, it is not easy to describe without diagrams. The endless band principle is used. There are two specially constructed spools located at each end of a centrally pivoted arm. The centre of each spool binds the film in such a manner that the film band takes the form of a double layer, looped into the spool-centres at both extremities. Thus two layers of film are continually passing between the spools.

The top layer passes through the projector and the bottom layer passes idly underneath. When the spool which has been paying out film becomes empty the changed line of the idle film throws into action mechanism which causes the two spools to change places. The layer of film last projected then becomes idle in its turn. This cycle of events will repeat itself automatically as often as desired.

General Advantages

Alternatively, the turnover of the arm which carries the spool can be made to actuate a cut-out each time the end of the subject is reached. An automatic cinema is in this case provided which can be turned on by the public, since it starts each time at the proper beginning and does not require switching off by hand.

Further general advantages of this method over the single-reel method of endless band projection are absence of "creep" and a straight film track. Pulling up or down is also avoided, so that up to 1,250 ft. of standard film can be carried without difficulty. In order to make full use of this fact the cabinet which contains the apparatus has been designed on lines which aim at the effective showing of a comparatively large picture. The use of a 1,000 watt lamp, combined with a large aperture rear projection lens, ensures a well-lit daylight picture on the 27-inch ground-glass screen.

---

equipments are prevented from securing maximum efficiency by the prohibitive cost of replacement. This new De Forest Clinic plan is calculated to remove the expense item as a factor in replacement.

The assumption by the De Forest Clinic of the work of surveying present sound equipment implies a responsibility on their part to bring the sound reproduction in a given theatre up to maximum efficiency.

Low-Cost, Colored Sound Pictures

THE ever-growing success of *Sonochrome* is based on one simple fact. This Eastman film meets the demands of the new-day motion picture, by giving both color and sound-on-film—*at the cost of ordinary black-and-white.*

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Projection From Afar

THE following information was culled from a recent issue of a motion picture trade paper to which it was contributed by one P. V. whose inexpensive advice is reminiscent of those who make a practice of directing the activities of a projection room staff either from a nicely upholstered and comfortable opera chair or an editorial desk. Witness:

"Rogue Song"

When a picture as great as M-G-M's new "Rogue Song" is sent into the projection room, it ought to be wrapped in a sheet of directions, and this is it: "Not too loud!" I can well understand the temptation that raises its ugly head when "Rogue Song" comes along. Here is the finest voice the screen has yet heard, I can imagine projectionists saying to themselves, perhaps the greatest voice the screen will ever hear. Why keep it from the public? Let 'em have it!

Some such thought must have animated those in charge of the sound at the Astor theatre on Broadway the opening night of this great picture starring Lawrence Tibbett, the Metropolitan Opera star. Or perhaps it was accident, but the result was the same. Every time that Tibbett was called upon to sing, his voice was magnified to the point that the back-walls of the theatre were assaulted, occasionally his voice roared and bellowed, and at times your ear-drums were assailed. Furthermore, ground noises were magnified at the same time, to the point where they were distinctly annoying.

"Blowing Up" the Squeaks

I don't know why anybody should have the idea that Tibbett's voice needs magnification. Anybody who has ever heard him at the Metropolitan, in any one of his roles, knows perfectly well that he can take care of himself in the biggest of houses. Tibbett is no whispering baritone, whose thin little squeaks have to be blown up in order to be heard.

You couldn't possibly do more with Lawrence Tibbett's voice than reproduce it exactly as he himself projects it. If the talking pictures would appreciate this, be content to do this and no more, then something very great would be achieved. Magnifying Tibbett's voice is like doing "The Ten Commandments" with 24 apostles.

All of which is very nice—depending on one's point of view. But as a point of general information, it might not be amiss to say here that the projection staff at the "Rogue Song" premiere had nothing to do with the volume of sound with which the "back-walls of the theatre were assaulted." The volume of sound was *regulated from the auditorium* by a person *selected by the producer*, and this monitor *was not* a projectionist. Which merely goes to prove that, despite rehearsal and the advantages of a suitable monitor in the audience, sound picture volume control is not as easy as it looks to those gentlemen who may know pictures but who probably know very little about sound technique.

Recording Defects

Further, if with all these advantages the sound was so unsatisfactory, what chance has a projectionist, busy with his apparatus and walled in behind glass ports, to regulate sound properly without adequate rehearsal?

Further, as another point of general information, the recording job on "Rogue Song" was not so good, and Mr. Lawrence Tibbett of the Metropolitan Opera Co. would seem to have much to learn about sound picture technique.

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A PERFECTED Optical Mount using *One Lens*—your *standard* lens. No changing—no prisms—no uncertainty. Perfect alignment—perfect focus—with the startlingly simple GoldE Uni-Lens Mount and Proportionate Centering Aperture.

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The GoldE Uni-Lens Mount and the Proportionate Centering Aperture make a unit which will not be displaced by any other system.

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Entire system includes the accurately machined GoldE Uni-Lens Mount—List Price, $25.00—using the *original* house lens, and the Centering, Proportionate Aperture milled and fitted into E16 Simplex Gate—List Price: $35.00.

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Of course no one would think of eating volume controls. But there is nevertheless as much difference between ordinary, hand-me-down, stock volume controls and the CLAROSTAT volume controls fitted to your precise needs, as there is between a plain *table d'hote* and the *a la carte* feast.

CLAROSTAT volume controls are strictly *a la carte*. They are designed to meet your specific requirements. Unique winding permits of tapering resistance curve to match exact needs. Compact. Foolproof. Dust-proof. Noiseless. Wear-proof. Provided in single, duo and triple units, each unit with desired resistance variation, yet single control operation. Strictly *a la carte*. What will you have, please?

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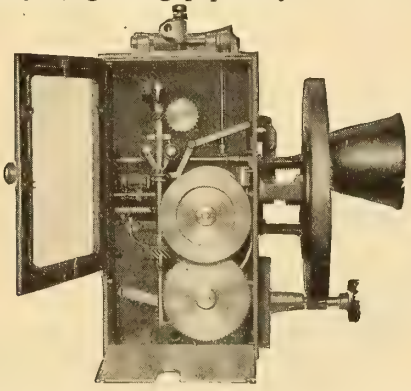
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Projection Council Election

LESTER B. ISAAC has resigned as President of the Projection Advisory Council. In a letter to P. A. McGuire, executive Vice-President of the Council, Mr. Isaac proffered his resignation and stated that his duties as Supervisor of Projection for Loew's, Inc., prevented his giving to work of the Council the time and attention which he knew to be necessary in view of the rapid expansion of Council work and the mounting membership. Mr. Isaac's letter in which he asked to be relieved from his duties as President is given here in part:

"It is a source of deep regret to me that I have been unable to give the attention to the Projection Advisory Council I would like to and which it so well deserves. The work of my present position, as Supervisor of Projection for Loew's, has been so greatly enlarged in detail and scope, I find it utterly impossible to give the proper attention to other activities in which I am interested.

". . . It is also a source of deep satisfaction to me that I have been able to play an important part in the founding of the Projection Advisory Council. The remarkable success of the Council, in so short a time, speaks for itself and it is unnecessary for me to explain in this letter why I have so much confidence in the organization.

"Under the circumstances I feel that it would be inadvisable for me to continue as President of the Council and that someone should be elected who can give more time to the organization. There are certain details which will require the attention of a President with more time than I can spare just now.

"You may be assured of my continued interest in the work of the Projection Advisory Council and that I have an abiding faith that it can be made a great constructive force for the benefit of projection and the entire motion picture industry. I will be glad to give you and the incoming Officers all the active assistance and goodwill in my power, and trust that you will not fail to call upon me any time I can be of any help."

Special Election Meeting

Mr. McGuire has informed President Isaac that he will present the resignation to the Board of Directors of the Council with real regret, and that only Mr. Isaac's insistence that he be relieved of his Council duties precludes the return of the resignation unaccepted.

(*Continued on page* 44)



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DOUBLE CHANNEL

RACK and PANEL AMPLIFIER

The last word—a rack and panel double channel amplifier *at a reasonable price.* Booth speaker with volume control is incorporated in panel.

Designed with the minimum number of controls. One handle controls both channels plus auditorium speaker fields. Simplicity and swift, sure, undistorted action are *now* yours.

Specifications:

Amplifier is entirely A. C. operated and may be had for 25, 40 or 60 cycle on 100 or 220 volt line.

Powerful, undistorted, amplification volume.

Will operate on 120 or 127 volts.

Impedance is very high—25,000 to 50,000 ohms at 100 cycles. This makes possible its use as a voltage drop device.

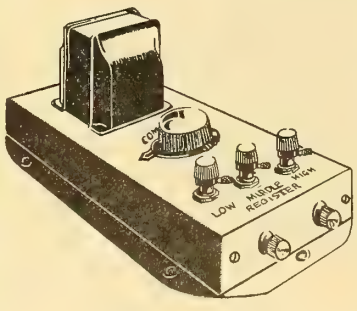
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—assures complete sound control



Your patrons demand the *best* in "Talkies"—you can give it to them with S-A-F 3 equipment! Inexpensive, easily installed, and simple to operate. A mere turn of a knob eliminates the unnaturalness in voice, the shrillness in notes and the unpleasantness and echoes of sounds. Your audience will be grateful for this improvement—and your box office will be busier!

S-A-F 3 was designed by Simplimus engineers—one of the oldest groups of engineers in the talking equipment industry—they have always led in offering improvements! Send the coupon below for complete information on S-A-F 3 and the course of sound lectures offered to the trade.

SAF ELECTRICAL EQUIPMENT CO., Boston, Mass.

Gentlemen: Kindly send me free bulletin on S-A-F 3 and place my name on your list to receive the course of lectures on the latest acoustical and electrical advances in sound recording and reproduction, written by leading engineers, professors and experts.

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Occupation .....

Stamford Local Union School Attendance Obligatory

Largely through the efforts of Business Representative Nicholas Trimboli, Local Union 449 of Stamford, Conn., has been enabled to organize a school for instruction of its members in sound projection. In line with the opinions expressed on several occasions in *Motion Picture Projectionist* and in keeping with the advice of International President Canavan, Local 449 felt that any instruction which would be given its members in sound projection work should be under the direction of Local officers. Then, too, it was felt that stagehands should receive first consideration in break-in work, and the school provided an excellent means for this work.

The first lessons in the school will deal strictly with fundamentals, irrespective of the standing of the various men enrolled. For those to whom elementary work is not new these first few lessons will serve as a review. Attendance at the school sessions is obligatory upon all Local Union members, and no one will be permitted to shirk attendance until he has given satisfactory proof by examination of his knowledge of the school work.—E. RODGERS, Secretary.

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To insure projection as good as you had before Sound, to get the best reproduction from your sound outfit, you must have the right kind of a screen.

Vocalite Sound Screen is proven best by scientific test. Many successful installations have proved it to be superior in light, definition, and tone quality.

It is the only screen optically and chemically correct for the projection of Colored Pictures.

Full information will be sent on request, cost no higher than any good screen.

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Porous but not perforated

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The First Screen Scientifically Perfected for Sound Pictures

Beaded Screen Corp.
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Your Preference, Please!

THE editors of THE MOTION PICTURE PROJECTIONIST solicit your aid to the end that this publication may be of the maximum service to you. Every subscriber can do his bit to improve this service by using the space provided below to indicate his preference for special articles and other material in which he may be particularly interested.

Let us know your preference, please. All requests will receive attention in the order of their receipt, so act quickly. Use the blank below to tell us in just what subject you are particularly interested. Do it now!

Editor,
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I am interested in the following subjects, on which I should like to see information in THE MOTION PICTURE PROJECTIONIST:

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P. A. C. Election

(*Continued from page* 42)

A special meeting of the Projection Advisory Council has been called for March 25th at Town Hall in New York City, at which time a new President and other Council officers will be chosen for the coming year. The newly elected officers will in turn appoint the various committee heads to direct the work of the Council in the next few months. A report of a special committee which has drawn up a report covering the aims of the Council and the work which should be done in the near future will also be read at this meeting.

A call has been issued to all Council members for the meeting on the 25th, and those who are unable to attend in person have been urged to send in their proxies to any member of the Nominating Committee. This committee is manned by Charles Eichhorn, Chairman; Thad Barrows, H. Stein, James J. Finn, and Lyle Wheeler. Proxies may be sent to any member of this committee.

Presidential Possibilities

Considerable interest has been aroused in the possible choice of the new Council president. It has been reported that the choice lies between three men as follows: Sidney Burton, Metropolitan Studios, Hollywood; Thad Barrows, President Local Union 182, Boston, and Lawrence Katz, Local Union 488 and I. A. District Representative. The choice of the membership will not, of course, be definitely known until the 25th, at which time personal and proxy votes will be cast.

Cameraman's New Scale

Producers and officers of International Photographers' Local 659 have made new arrangements regarding working hours whereby cameramen may work more than 10 hours at a stretch provided first cameramen are paid a flat rate of $12.50 an hour for overtime, with second cameramen, still men and assistants also being paid an overtime scale. Double pay will apply for holidays.

Under the old arrangement cameramen could not be worked more than 16 hours at a stretch except in emergencies, and much friction arose between producers and cameramen over emergency cases.

GoldE Humidaire System

A new development which is known as the Humidaire System is engaging the attention of the GoldE Manufacturing Co. of Chicago at present. Details of this new product are not yet available because of patent considerations, but M. H. Goldberg, president of the GoldE Co. and well-known Mid-West projectionist, promises to supply full particulars on the development within a short time.

Recent Film Fires Focus Attention on Safety

RECENT serious fires in motion picture studios, theatres and other branches of the industry have prompted many local and state authorities to examine closely the laws pertaining to fire prevention in the motion picture industry and the degree of fidelity with which these laws are observed and enforced. Several states have just passed laws bearing on this highly important phase of fire prevention work, the result of which has been a renewed interest in a safe and sane method of fire prevention not only in the theatre projection room but in every activity which has to do with the handling of film. The following brief description of an outstanding contribution to the comfort and safety of theatre patrons and workers will supply information on this device to many who have asked: "What is Sentry Safety Control?"

The Sentry Safety Control consists of five units: douser, upper loop switch, lower loop switch, rotary switch and main control box. The douser switch unit is mounted on the cone of the lamphouse. Its function is to start the projector through a remote control system and also to cause the douser plate to fall, cutting off the light when the emergency arises. The douser is instantaneous and positive in action.

The upper loop switch is mounted adjacent to the sprocket which feeds the upper loop, and is so arranged as to detect either an increase or loss in the top loop of film passing through the machine. A plate deflector is also placed in such a position as to prevent the escape of film after a break occurs at the top sprocket.

The lower loop switch unit is mounted near the film trap where the film enters the lower magazine and is equipped with an idler arranged to ride the film during the operation of the machine. Failure of the film to support this idler causes the switch to operate. The rotary switch is driven direct from the projector mechanism and functions when the speed of the projector decreases to a predetermined degree.

Main Control Unit

The main control box unit houses the motor control equipment and serves as junction box for all switch

I. A. Convention to West Coast

The forthcoming general convention of the International Alliance will be held in Los Angeles, California, June 2 to 5, according to a recent announcement of the Executive Board of the Alliance. This will be the first time in 17 years that an I. A. convention has been held on the West coast.

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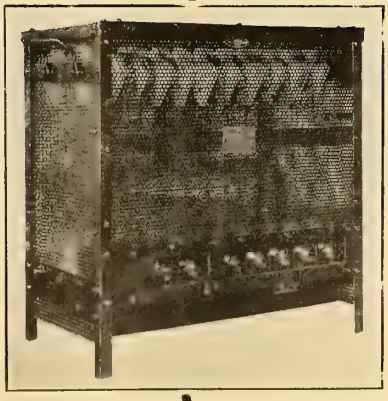
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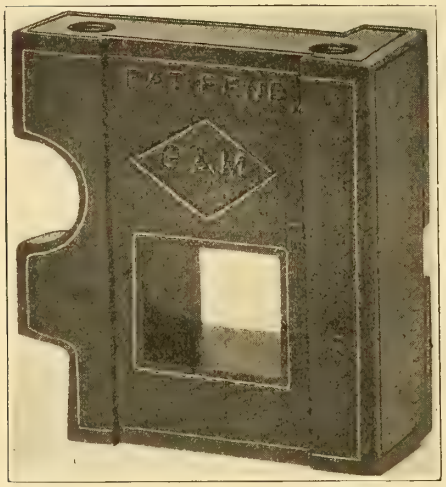
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wires. The contacts carrying the motor current have a capacity of thirty amperes. Margin of safety here is evident from the fact that projector motors are rated five amperes or less. Silver is used for the contacts of all the switches. The Sentry Safety Control is subject to a dielectric strength test of 1,250 volts and overload tests of 150 per cent rated current.

Fire on a motion picture machine equipped with Sentry Safety Control is utterly impossible because fire hazard occurs on the stoppage of film before the ray of light, and this can never happen with Sentry. All possible accidents that would bring this hazard up, have been taken care of by this machine. Sentry Safety service to the theatre means a lessening of the fire hazard to such a great extent that there is a tendency at the present time to lower the insurance rates on buildings, contents, use and occupancy and public liability. This is due to the Sentry Safety equipped projectors, for they have never had a fire and it is the only method that can prevent fire with modern highly inflammable nitro-cellulose film when exposed to the intense heat of the modern lamps.

Sentry Service

Sentry Safety Control in the sound equipped booth is practically indispensable. It simplified starting and fading in to such an extent that the usual troubles of operating with this new mode of entertainment are almost entirely eliminated. It is really another assistant in the projection room and the projectionist can give a sound show with Sentry-equipped machines that is much superior to those which are not equipped with this device. Furthermore, there is no possibility of destroying any great amount of film which, in a sound show, means serious hindrance to the show. No matter what condition arises on a Sentry-equipped projector, the machine is stopped immediately, eliminating any possibility of damage to the film itself from causes other than fire, and fire is impossible.

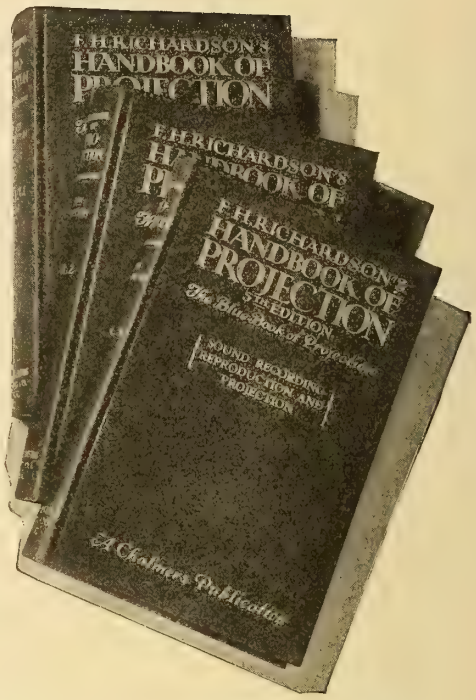
Sentry Safety service does not stop with the installation of this device, but it is inspected and serviced periodically, and any change in equipment necessary in a booth, the Sentry equipment and service is changed to meet the new condition at no expense to the theatre. There is no charge for the devices in the sense of a sale. They are leased on a basis of two dollars and fifty cents ($2.50) per machine per week. This price includes servicing and inspection.

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Separate Sound Print in Key Theatres

ALTHOUGH the practice is too expensive and inconvenient for general adoption, the use of a separate film for the sound track has been found advantageous in obtaining better quality of reproduction, according to officials of the Loew projection and sound department. The system has been employed for some time at the Astor, where M-G-M presents its special Broadway showings, and the only other use made of the double-reel method so far has been by Sid Grauman on the Coast.

Dummy Head Required

The system, which is under exclusive patent, requires the use of a dummy head mounted on a pedestal. By having the sound on a separate track, mechanical flutter and jerking is eliminated because the reel carrying the sound is permitted to move continuously and uniformly; whereas the reel with the picture must move in frames with sufficient pause for projection of the image on the screen.

Another advantage, applying especially to long-run houses, is that the sound track, which usually wears out quicker than the picture, may be replaced independently whenever necessary, without substituting a new reel for the entire picture. In the case of productions filmed in color, the sound track is recorded on black and white film.

Not For General Use

Because of the double cost involved in the making and handling of two sets of reels, the system is considered out of the question for theatres at large and no efforts are being made to install it in any other houses controlled by Loew. For special run showings at $2, however, it is believed that superiority of the performance justifies the extra expense.

A separate sound track method, on the same order as that used by M-G-M, was tried out some time ago by RCA, and subsequently dropped because no special advantages could be seen in it for the trade at large.

An Added Worry

Three projectionists in Birmingham, Alabama, were arrested recently on a bench warrant charging contempt of court in aiding and abetting the showing of a motion picture which had been officially banned by city authorities. The projectionists are not, of course, directly responsible for the infraction of this particular municipal ordinance, but it would seem that they come under that old classification of "accessories."

Oh well, everybody who is anybody knows that *some* work must be found these days for business representatives.

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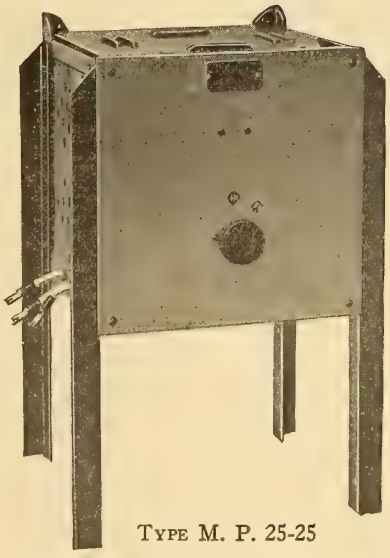
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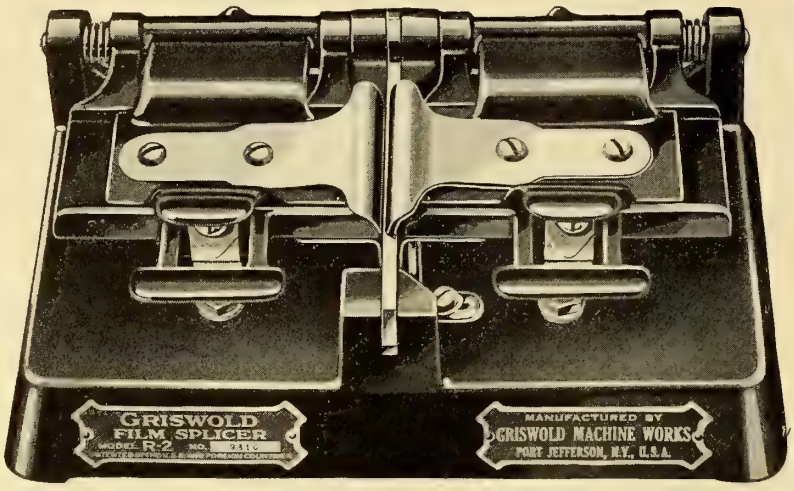
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Quality of Reproduction Is Constantly Improving

THE quality of reproduction and the number of theatres giving satisfactory reproduction is showing a steady and gratifying increase, according to H. M. Wilcox, operating manager of Electrical Research Products, whose duties take him on frequent trips of inspection to theatres in every part of the country where the Western Electric sound system has been installed. An average of about 75 per cent of the houses visited by Mr. Wilcox during the last six months of 1929, qualified under the "Good" classification, while 84 per cent of the houses visited during the first six weeks of 1930 were rated good. This situation, according to Mr. Wilcox, has been brought about by the realization that the quality of reproduction is reflected in the attendance.

"Theatre managers realize this," Mr. Wilcox said, "and as a result one hears increasingly good reproduction in a larger number of houses. Better supervision and a greater interest on the part of managers and projectionists are the main causes responsible for this change.

"Our nation wide service staff which regularly inspects our equipment installed in more than 3,500 theatres, was founded on the theory that the best way to eliminate trouble is to forestall it. As a result more than 93 per cent of the calls made by our service organization are purely preventative." In January this staff made almost 11,000 calls and less than 7 per cent of these were because of trouble of any kind. During the month upward of 105,000 performances were heard over the Western Electric equipment in the United States.

"Showmen realizing the importance of good reproduction are going to greater pains to see that they and their staffs realize the points that make for good reproduction. Pictures are being rehearsed in advance of showing to assure proper volume control, while equipment is being studied zealously and cared for jealously.

"It is this combination of watchful inspection and growing alertness that makes good reproduction an automatic part of every well-run theatre. It promises so bright an outlook that we are willing to predict that the figure of 84 per cent of theatres with good reproduction can be raised considerably in the future."

24-Hour Grind Theatre

New York City is to have its first 24-hour grind motion picture house. The Columbia Theatre at 58th and 8th Avenue (midtown section), will shortly go into the new policy and, once pursuing its new schedule, will never close. The Columbia is now running on a seven-day, 16-hour daily schedule.

Defective Vision Campaign

A NATIONWIDE drive to awaken the people of America to the dangers of impaired eyesight and poor vision is now in progress under the sponsorship of The Eyesight Conservation Council of America. Asserting that this danger may finally be overcome only by placing the facts squarely before the people of the country, the Council is bending every effort to secure as wide a distribution of its educational material and statistical reports as possible. There is appended hereto a recent statement of the Council on the relation of poor vision to industry:

The value of your eyes—the sense of sight—cannot be expressed in any terms. Next to life itself is vision; and yet, millions have defective eyes. The great majority are unaware of impaired vision and do not know that theirs is less than a full measure of the most valued of the senses. Many others do not understand that a considerable degree of the vision they do enjoy is gained through nerve exhausting eye strain.

Millions Lost Yearly by Poor Vision

Looking at this condition from a purely economic angle, one is appalled at the resulting waste of effort and the inefficiency of millions who daily contend with the handicap of faulty vision. As to the prevalence of defective eyesight, recent studies show some startling results.

In the examination of more than 10,000 employes in factories and commercial houses, 53 per cent were found with uncorrected faulty vision, and 13 per cent had defects which were corrected, making a total of 66 per cent with defective eyes. In one manufacturing establishment, more than 70 per cent were found with eye defects. In another plant the following condition was discovered: Glasses worn and satisfactory, 8+%; glasses needed and ordered, 83+%; no glasses needed, 8+%. As an example of inefficiency and resulting waste, 20 per cent of the inspectors in a large factory were found to be unable to see sufficiently well to detect defects in the product they were inspecting. This is an intolerable situation and inexcusable when the remedy is so simple and inexpensive.

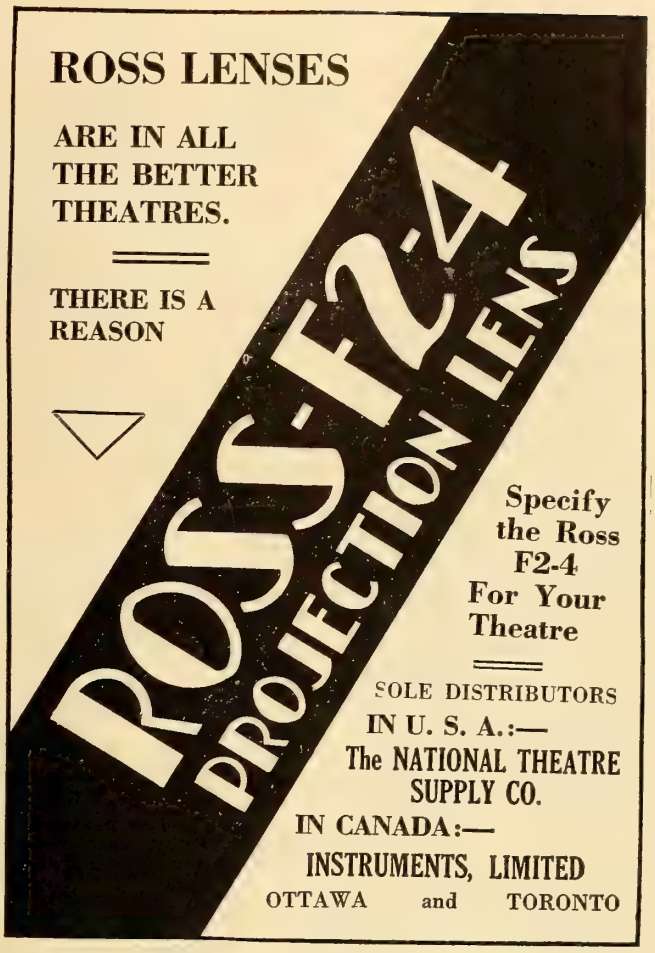
25 Million in U. S. Have Defective Vision

There are 42,000,000 gainfully employed in the United States. More than twenty-five million are handicapped by defective vision or eye strain. What does this prevalence of defective eyesight mean in the store, the office, the factory, the bank and in every place of business? What does it mean to production? That is our big problem today—greater production at less cost. The nation must produce more and waste less. Full production and the reduction of waste to the minimum are possible only when the individual is normal physically.

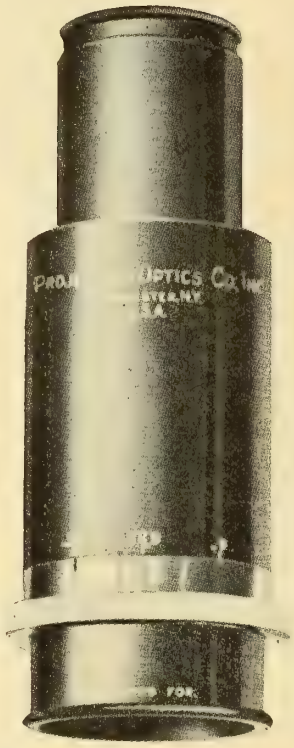
We have given more attention to the perfecting of machinery that we have to the correcting of physical defects in the individual. We have developed the mechanical and neglected the man. More consideration for the human element is needed—more attention to the physical fitness of the individual. No physical defect contributes more directly to fatigue and inefficiency than eye strain, or is more responsible for waste of vitality, effort, time and material.

How can we be more efficient? How can we successfully compete with the cheaper labor and longer hours of employment in other countries? By correcting physical defects and so directly increasing the efficiency and the productivity of the individual. Every manager should see to it that the eyes of all associated with him are corrected to compensate for defects. It will pay from a purely business standpoint, being reflected in better service, fewer mistakes and higher standards. There are comparatively few positions filled as well by cripples as by persons physically normal. Still, there are many people apparently normal and presumably efficient who are to some degree crippled by defective vision and, therefore, not as efficient as they should be.

From the foregoing it is clear that defective vision is very prevalent among our industrial army and any factor which affects so great a proportion of our industrial workers should be studied so that the results which this condition causes may be recognized and known. There is no condition of advantage to either employer or employe from defective vision and whatever results that do accrue from this condition are of a detrimental rather than an advantageous nature. It is logical to assume without actual figures that defective vision may be and probably often is an accident causing hazard for a person laboring with poor eyesight may meet with an accident due to this condition which would not occur had that person enjoyed good eyesight.







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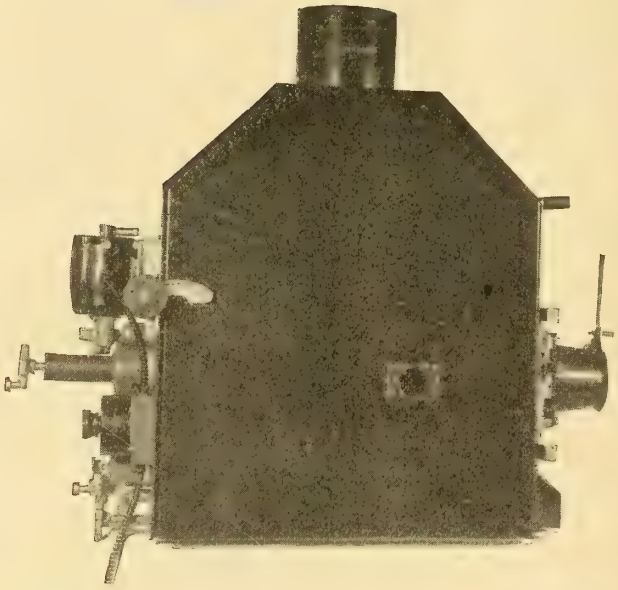
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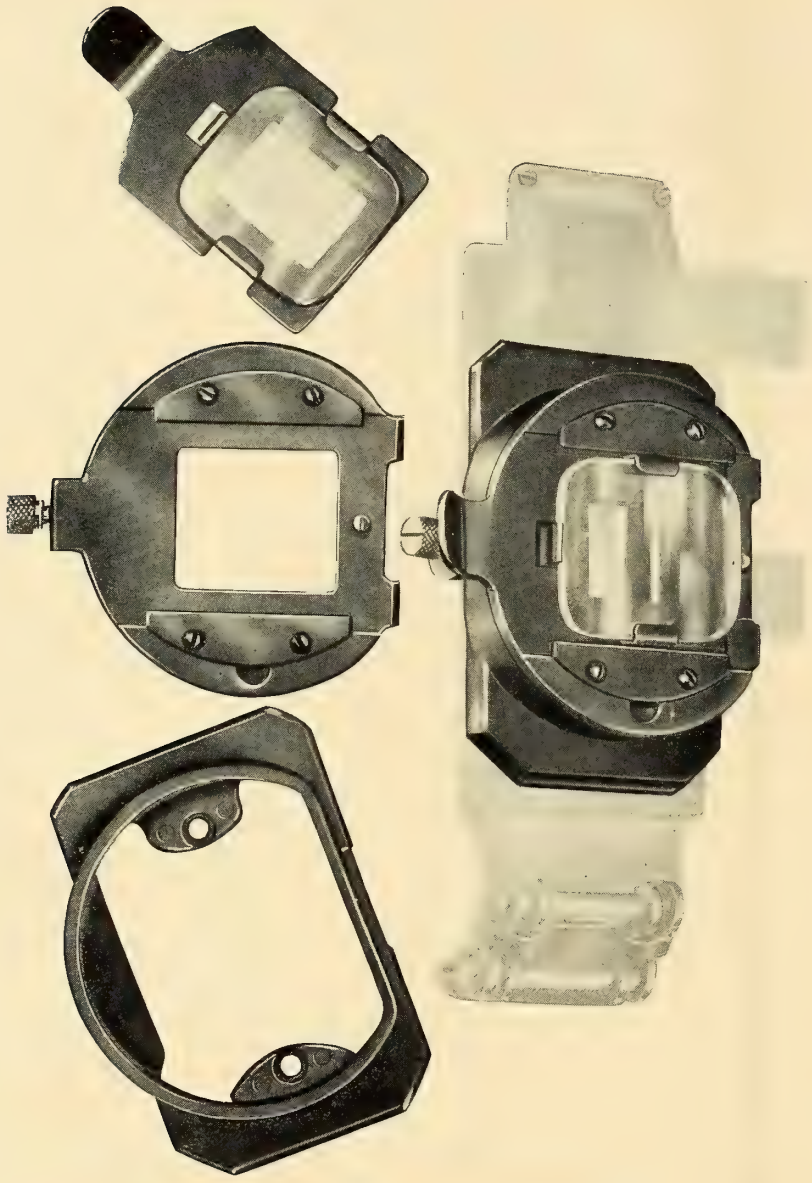
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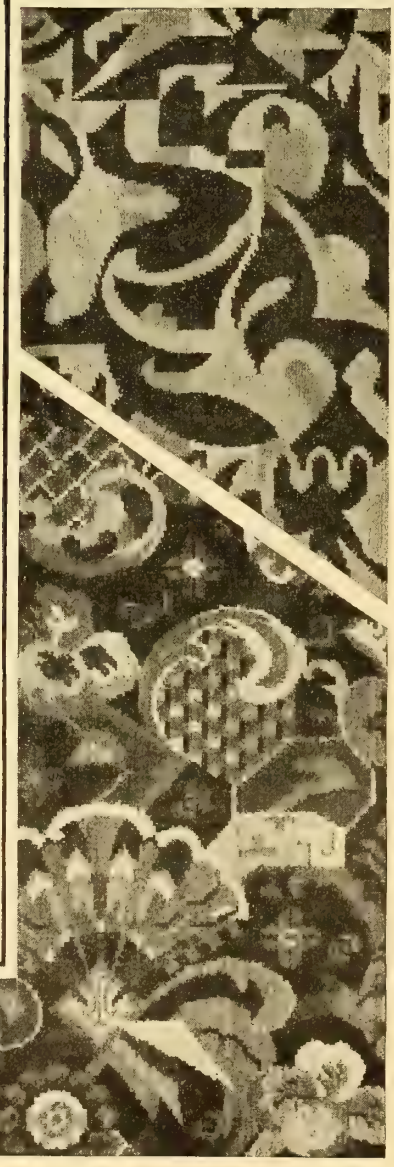
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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, of

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COUNTY OF NEW YORK }

Before me, a notary Public in and for the State and county aforesaid, personally appeared James J. Finn, who, having been duly sworn according to law, deposes and says that he is the Editor of MOTION PICTURE PROJECTIONIST, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and regulations, printed on the reverse of this form, to wit:

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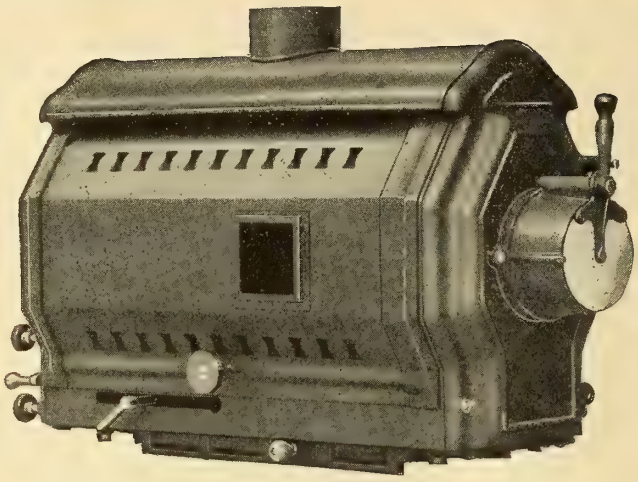
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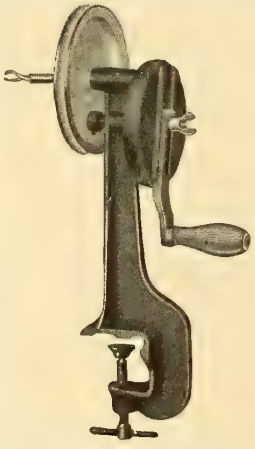
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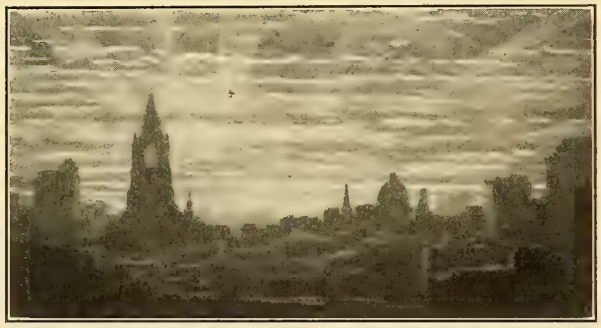
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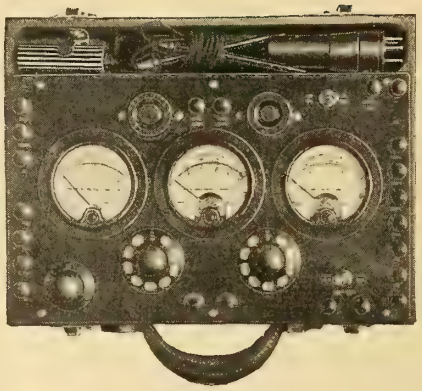
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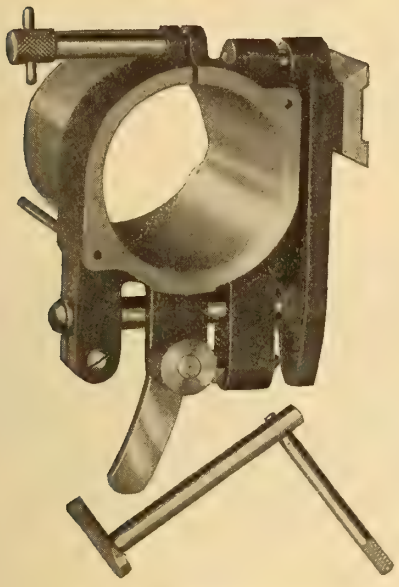
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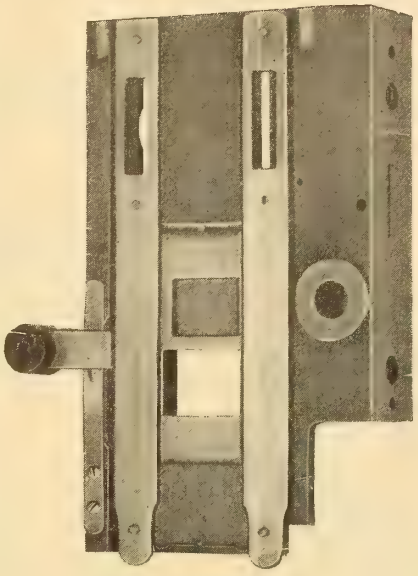
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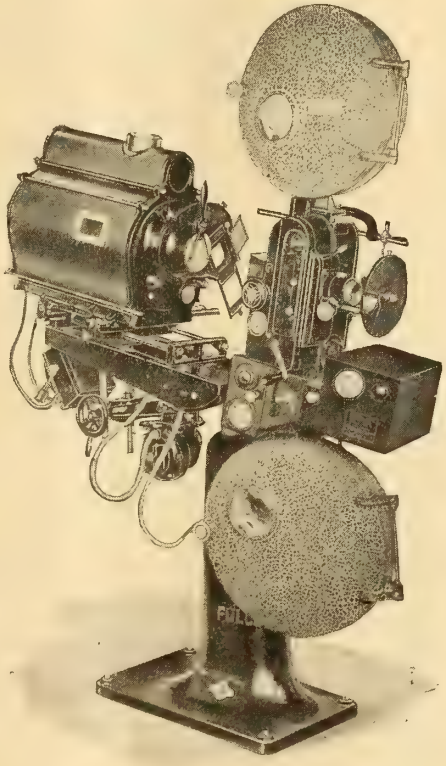
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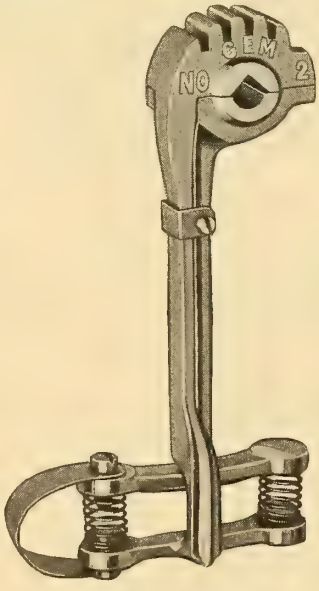
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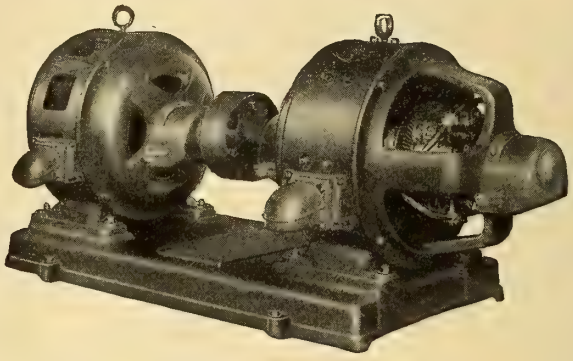
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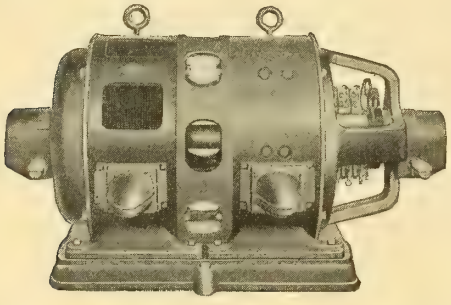
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A New Method of Blocking Out Splices in Sound Film

By J. I. CRABTREE and C. E. IVES*
Research Laboratory, Eastman Kodak Company

A SPLICE in motion picture film which bears a sound record usually introduces extraneous noise in the reproduced sounds unless some means is taken to obscure it. Rapid variations in light transmission of the sound record are productive of sound and the reproducing equipment is, of course, unable to distinguish between the record proper and such extraneous variations.

It is not difficult to see that a badly aligned splice surrounded by cement smears, finger prints, abrasions, and dirt spots could produce noise. Even though the splice is made with the greatest care and precision, however, a very objectionable noise might be introduced as a result of the passage of a splice joining parts of the sound record between which there is an abrupt change in transmission. This condition is liable to be encountered even if the method of joining were capable of eliminating all other mechanical imperfections, such as roughness of the cut edge and light loss produced by refraction at the edge. Therefore, noise will be produced if the change in transmission between the contiguous areas is large and abrupt enough to come within the range of the reproducer.

If the transmission of the area illuminated by the slit in the reproducer is reduced gradually until it is insignificant at the time when the splice passes, then no noise will be made by the splice in passing. The rate of decrease of transmission must be less than that corresponding to the minimum frequency attainable in the reproducer system.

Remedy for Splice Noise

It has been found possible to eliminate the splice noise by applying an opaque coating to the sound track (Fig. 1), in such a way that as the film travels past the slit the effective transmission is gradually reduced to a very small value and then increased in the same manner.[1]

It is much easier to apply an opaque coating in the shape of a wedge than to vary the thickness of the coating, so the overlay usually is made to resemble a ten to forty cycle variable area signal.

When a splice is "inked-out" or "painted-out" in this way in the negative, it leaves an area of high transmission in the positive which is very easily scarred so that it might cause ground noise. In the positive, the "paint-out" does its work very well. India ink has been used in this way but becomes brittle and develops very noisy cracks. An opaque lacquer has proven more satisfactory.

In a processing laboratory it is quite possible to make good "paint-outs" by applying a black lacquer with a fine brush either with or without the assistance of a stencil. In the hands of a skilled worker making many hundreds in a day, this method has proven satisfactory, but in the projection room of a theater different conditions exist. It is often necessary for the projectionist to make a number of splices in a few minutes when a new picture is received, and since he is not doing the brush work frequently, it is difficult for him to make a satisfactory "paint-out" quickly with the result that more noise is liable to be introduced by a poor "paint-out" than would have resulted from the splice in the first place. It was obvious that the solution of this problem lay not alone in the use of a quick drying lacquer, but in devising a rapid method of applying it.

Various types of stencils constructed of the following materials were tried: cardboard, rubber, inking roller gelatin, steel and rubber plated metal and steel. A slow drying lacquer or ink could be used with any of the above devices, but in the case of rapidly drying lacquers, if the brush contained sufficient liquid to make the film opaque with one or two applications, the more mobile, rapidly drying inks were sucked in under the edge of the stencil by capillary attraction, and a very irregular edge was produced. This effect did not occur

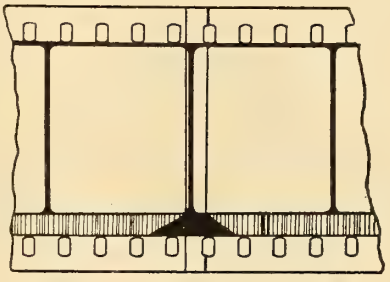


Fig. 1. A typical paint-out

when a thick lacquer was used, or when very small quantities of the thin lacquer were applied repeatedly, but this procedure was so slow as to be of no advantage. It was then considered that an opaque sticker or patch of suitable material and design could be applied rapidly enough for this purpose. A gummed paper patch was first tried. This could be applied readily and eliminated the splice noise, but became brittle and sometimes peeled off after the film had been projected a few times.

Decalcomania transfers were also tried but found unsuitable. These transfers as purchased consist of a sheet of material, 0.001 inch thick, attached to a thick paper. They are soaked in water and the transfer then floated off onto the gelatin coated side of the film. This type of patch dries too slowly and does not become intimately attached to the film in the region of the splice, because there is no fusing together as with a cemented patch.

An opaque film was then made by incorporating dye and pigment in motion picture film base, but when the cement was applied to patches made from such film they curled excessively. A critical thickness of four-thousandths of an inch was necessary in order to prevent curling. This thickness was considered excessive. If the film base was coated with a gelatin layer, this materially reduced the curling tendency.

The film patch material finally adopted consisted of clear film base, emulsion-coated, and rendered opaque by exposure and development. A film of minimum thickness (0.003 inch) was chosen so as to conform readily to the irregular surface of the splice and prevent the splice from becoming too thick and stiff.

This type of splice (Fig. 2) was very successful. The patches were tested by applying them over splices in a positive film which was then run through a projection machine until the film broke down completely. The

* Communication No. 41 from the Kodak Research Laboratories.

[1] Movietone Bulletin, 1, (Aug. 4, 1928).

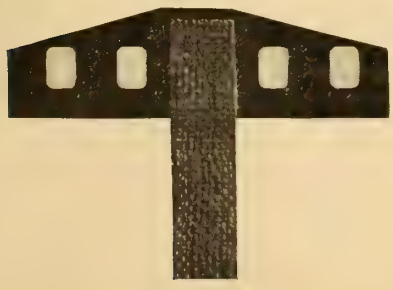


Fig. 2. The patch with and without finger tab



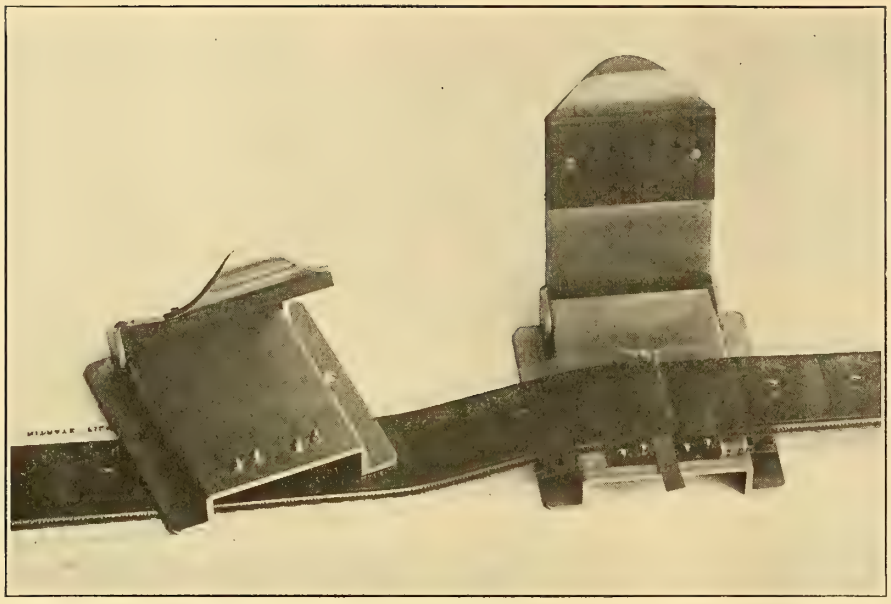


Fig. 3. Registration block showing film and patch in position on pins

patches were intact up to the time when the perforations commenced to fracture at the corners.

The Splicing Operation

The patch is applied with the aid of a registration block shown in Fig. 3. This consists of a bed plate fitted with registration pins and a pressure platen fitted with a rubber pressure plate. The platen is hinged to the bed and the rubber pressure surface is cut out so that it fits closely around the pins.

The motion picture film is placed on the registration block with the support side up and that side of the strip which bears the sound record in engagement with the four pins. The splice is placed at or near the center of the block. The pins fit the perforations so closely that pressure clips for holding the film in place are unnecessary. When the film is in position on the block the patch is picked up and held at one end by means of tweezers or an attached tab while cement is applied to the side which is to come in contact with the film strip. The cement application is accomplished by a single stroke of a soft cementing brush of medium size. The patch is placed immediately on the registration pins, the pressure plate brought down, and held in position for about five seconds.

The patch which proved most successful was so made that it covered the entire width of the sound track completely and extended as far as possible toward the center of the film strip without entering the picture area. Some of the factors which entered into consideration of the best design for the patch are discussed below.

Design of Patch

As mentioned above, the patch or a "paint-out" performs its function by masking off an area of sound track of varying width so as to reduce the total transmission of the area illuminated by the slit in the reproducer at a rate which is insufficiently rapid to cause the recorder to generate an audible sound, and then, when the splice is past, uncovering the track in a like manner.

The reproducers now in use are capable of generating sounds of a frequency not less than 20 to 50 cycles per second. Therefore, if the splice is to be designed so that it will cause no noise of itself, it should vary the transmission as it would be varied by a signal whose frequency is not more than 20 cycles. Such a signal would be represented by a patch whose contour would be described by a sine curve of an amplitude corresponding to full modulation. Its length for 20 cycles would be:

$$\frac{18 \text{ inches}}{20} = 0.9 \text{ inch.}$$

Now, it might be argued that this length causes a noticeable discontinuity in the sound. This is not so serious as it might seem. A patch having straight instead of curved sides has been considered because it is much more easily made, especially if it is to be cut by hand. If the patch is shorter (about one-half this length, as has been recommended), the harmonics introduced by using a straight edge for the cut-off as an approximation for an edge of curved contour, are of a higher frequency and therefore more prominent. Also, the fundamental is well within the range of the reproducer.

The following tests were made with a view to arriving at a design which would be a compromise between one which would be audible and one which would obscure too much of the sound record.

A number of patches having dimensions indicated in Fig. 4 as shown in Table 1 were made and applied to (1) an oscillator record of low modulation (frequency 540 cycles); (2) a strip of clear film of density about 0.1; and (3) a strip of film flashed and developed to produce a uniform density of about 0.7. In each of these films two splices were made with 5 feet of film between them and then 17 feet were skipped before another splice was made. The first splice was left bare, the second was covered with the patch, and then 5 feet beyond the second splice a patch was mounted at a point where there was no splice. In this way each of the patches in the table was prepared for test. In order not to have any bad corners it is desirable to avoid cutting across perforations so that the choice of lengths is limited.

The tests were made by running these strips through a standard type of reproducer operated at a normal gain setting. The modulation of the oscillator record was such as to produce at this gain setting a volume corresponding to normal speech. The noise from a well made splice, made with a widely used mechanical splicing machine, was plainly audible.

In general, the noise produced by a plain splice was least noticeable in the oscillator records, more noticeable in the 0.7 density, and most in the 0.1 density film. The patch number 1 produced a plainly audible sound, number 2 was somewhat less loud, and numbers 3 and 4 were only just audible on the 0.1 density film and apparently about equally effective.

Numbers 3 and 4 were noticeable because of their obscuring the oscillator record for a perceptible duration of time. Number 2 did not cause a noticeable interruption. The best length of patch is therefore indicated by number 2 or 3, number 1 being noisy of itself and number 4 interfering with the record for an unnecessarily long period of time. With reproducing systems which are capable of reaching 20 to 30 cycles it is necessary to use the number 3 size, because the smaller patches make an offensively loud sound.

The patch should cover the splice at the widest point. This condition is satisfactorily fulfilled when the sound track is completely obscured for a distance equal to 0.098 inch each way

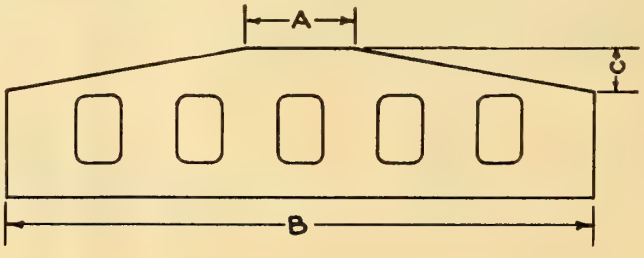


Fig. 4. Dimensioned sketch of patch

TABLE I

Experimental Patch Dimensions (See Fig. 4)

Patch No.	A	B	C
1	0.09 in.	0.29 in.	0.10-0.12 in.
2	0.1875 in.	0.65 in.	0.10-0.12 in.
3	0.1875 in.	1.00 in.	0.10-0.12 in.
4	0.1875 in.	1.40 in.	0.10-0.12 in.

of the center line of the central perforation (Fig. 4 at 4). This allows for the standard "full-hole" splice. It is advisable to have the patch extend inward almost to the picture frame. Then there is no danger of leaving part of the splice uncovered through an inaccuracy in mounting the patch.

A total length of 1.00 inch was found best because of these considerations. A spliced sound record film fitted with the patch is shown in Fig. 5. The sloping sides have a length along the sound track of, in this case, 1.00 — 0.1875 = 0.8125 inch, or 0.4102 inch each. This is slightly shorter than that for the one-half wave length at 20 cycles (0.45), and corresponds to a frequency of about 22 cycles.

The patch is very much easier to handle if it is supplied with a finger tab, consisting of a strip of stiff cloth attached with a non-permanent adhesive. (See Fig. 2 at left.) The tab is readily removed in the same manner as ordinary surgical adhesive tape.



Fig. 5. Spliced film with patch

Ideal Wide Film Size Is 70 Mm.

By GEORGE A. MITCHELL

Mitchell Camera Corp., Hollywood, Calif.

A FEW old facts presented anew. Wide film is old. The mere use of wide film is no novelty. Many have advocated its use in the past, and have pointed out its many advantages. There have also been others who have been careful to point out its disadvantages and until recently the latter have made the most progress with their argument.

The cost of changing the equipment was looked upon as an insurmountable obstacle. It took the talking picture to convince the profession that the public wanted the best obtainable, regardless of cost, and that it was economy to give the public something better if possible. Now wide film is going to get its just desserts and come into its own. Wide film is not a panacea for all ills; in fact, it is not a cure for any ills at all. It opens possibilities for bigger and better pictures.

Wide Film Popular

It is slightly more expensive, but the results justify the increase. I believe that within a very short time the public will be very emphatic in its discrimination between wide film pictures and the old 35 mm. standard. This is based upon conversation with people working with wide film and they all admit after viewing wide film for a while that the 35 mm. standard looks funny. There is no need here to go into the detail regarding the virtues of wide film. I believe that the industry is already sold on the proposition.

The question now before the industry is: "How wide should wide film be." Very little discussion takes place regarding the size and shape of perforations or the width of sound track, it all centers around millimeters, 48-65-70—or what is your idea?

Anyone of them is better than 35 mm. and almost in proportion to their width. I believe every theatre should show as wide a picture as their proscenium arch will permit. Our lenses won't permit this with absolute sharpness in the margins at the present time, but here is the point. Put your principal action in the center of the screen and let the margins go fuzzy if you please (we will have better lenses some day). It is much better to have your pictures fade off fuzzy on the side gradually than to stop the picture and restrict the view by a black border; concentrate your action near the center and the andience will not be aware that the margins are fuzzy. Look at twenty of the great masterpieces and note how much detail you can see near the margins.

Economic Considerations

Now the larger your film is, the less possibility there is of the grain becoming bothersome. A wide sound track is desirable for the ratio of grain size to slit width is reduced, therefore the ground noise is lessened.

The question of cost now comes up. Of course the wide film is going to cost more money, but not much more. Film as well as machinery will be more expensive. An important fact for the producer to remember is that the big cost on any production is labor. Don't forget that point.

Everyone knows that to design and develop any new process for any purpose is expensive. Often after a machine is designed and built the cost is only started for the changes necessary to develop the machine to practical perfection is problematical and often excessive. One way the studio can save lots of money is to adopt a process and machinery that is already developed and brought to a state of perfection to where it is commercial, and not try to develop some new system of width, pitch and perforation.

70 mm. Ideal Size

I do not believe that it is economically possible for two wide film systems to exist in the field and if various studios go ahead with several sizes of wide film I am sure the result will be a big loss to someone, which, in the last analysis, is a loss to the whole industry. No one likes to lose money and I don't believe anyone likes to see the other fellow lose money.

There is no engineering problem between 65 mm. and 70 mm. You can matt down to the 65 mm. size picture if you use 70 mm. but not the reverse. *Make the standard adequate;* 70 mm. is the logical and economical size it is *proven.*

Ask Projectionists' Aid in Returning Equipment

Circuit projection departments are asking that all theatre projectionists cooperate with house managers in seeing that all defective sound picture equipment is shipped out of the theatre promptly upon it being replaced. In some instances, a theatre is supplied with replacement equipment which, as a result of the old defective equipment not having been received at the sound company's clearing house, is billed to the home office projection department as new equipment.

Unwarranted Charges

Delay in returning defective equipment to the sound company complicates accounting procedure tremendously, and in addition often swells far out of proportion the equipment charge against a certain theatre. Projectionists are asked to do their bits in seeing that the house manager gets all defective equipment promptly, so that he may prepare for shipping it out immediately. Very often p. e. cells are let lie around the projection room, and finally they disappear entirely. This results in an unwarranted charge against the theatre.

All projection supervisors are notifying their men to cooperate with house managers in this respect.

Amplifier Input Control Panels

By Engineering Dept., RCA Photophone, Inc.

THE input control panel contains controls for adjusting the exciter lamp current and the volume of sound from the speakers, as well as the control for transferring sound projection from one projector to another. All of these controls operate through the use of two special types of resistors, one type known as a rheostat, and the other as a potentiometer. Before discussing the use and operation of these particular controls, it will be best to consider the action of resistors in electrical circuits.

All matter is composed of positive particles of electricity (protons), surrounded by negative particles of electricity (electrons), which are always in a state of rapid and violent motion about the protons. In some substances the electrons are not very strongly attracted to their corresponding protons, and the application of energy (chemical, magnetic, etc.), in the proper form will cause some of the electrons to move in a direction from a point of low to a point of high "potential"—as electrical pressure is called. This flow of electrons produces an electric current which flows from a point of "high" to a point of "low" "potential". New electrons to take the place of those which have traveled away from the point of low potential are supplied from the source of potential (battery, generator, etc.). In other words, the source of potential acts as a pump driving electrons into the point of low potential, and pumping them out of the point of high potential.

In some substances the electrons are so strongly attracted to their corresponding protons that it is impossible to move them by means of the potentials we are using. These substances are known as "non-conductors." In various stages between what are termed "conductors" and "non-conductors" are materials in which the electrons are comparatively hard to move, but which will carry a current depending upon the amount of electrical pressure applied. All conductors have some "resistance" to the flow of electric current.

Electrical Circuits

The flow of electric current in an electrical circuit is very similar in its action to the flow of water in a water system. To have a flow of either water or electricity, it is absolutely necessary to have first a pressure. Without pressure there is never any flow. In electrical circuits the pressure is called "potential," and it is measured in units called "volts." Since the unit of potential is called a volt, potential itself is quite often called "voltage."

If a pressure is applied to water in an open pipe line by means of a pump, the amount of water which will flow through the pipe depends on two things: (1) the pressure, and (2) the size of the pipe, which determines its resistance to the flow of water through it. If a certain pressure is applied to the pipe line, a certain flow of water will result. If this pressure is doubled, the rate of flow will be doubled; and, on the other hand, if the pressure is cut in half, the rate of flow will be halved.

In like manner, if the size of the pipe is doubled, the rate of flow will be doubled; and if the size of the pipe is decreased, the water will flow at a decreased rate in direct proportion to the decrease in the size of the pipe.

The same time is true of electrical circuits. If the current through an electrical circuit at a certain voltage is measured and then the voltage is doubled, the current reading also will be doubled. It can also be observed that, provided the pressure is kept constant and, instead, the size of the conductor is varied, either in length or cross-section, the current will change, also. Increasing the length of the conductor or decreasing its cross-sectional area will decrease the current, since this will increase the resistance.

All other things being equal, if the resistance of a circuit is cut in half, the current will be doubled; and if the resistance is cut to a third, the current will be trebled, and vice versa, that is, three times the resistance will result in one-third of the current, etc. These facts were first presented a definite rule by a man named Ohm, which resulted in the use of his name as applied to the unit of resistance. The unit of current is known as the *ampere*. The value of an ohm in resistance was so chosen that it would take an electrical pressure of 1 volt to force an electric current of 1 ampere through it. The equation expressing these values is known to all of us.

Rheostat Applications

Fig. 1 illustrates the operation of the rheostat and potentiometers used in RCA Photophone input control panels.

The exciter lamp rheostat contains a form around which a length of resistance wire is wound. This wire is made of such a material that it does not readily pass current through it, as compared to material used regularly in electrical circuits for ordinary connections. A sliding contact arm passes over this wire-wound form, and is controlled in its position by a knob on front of the control panel.

This rheostat is connected in series with the battery line to the exciter lamp, one connection being made to one end of the wire-wound form, the other connection being made to the sliding contact (Fig. 1). By moving

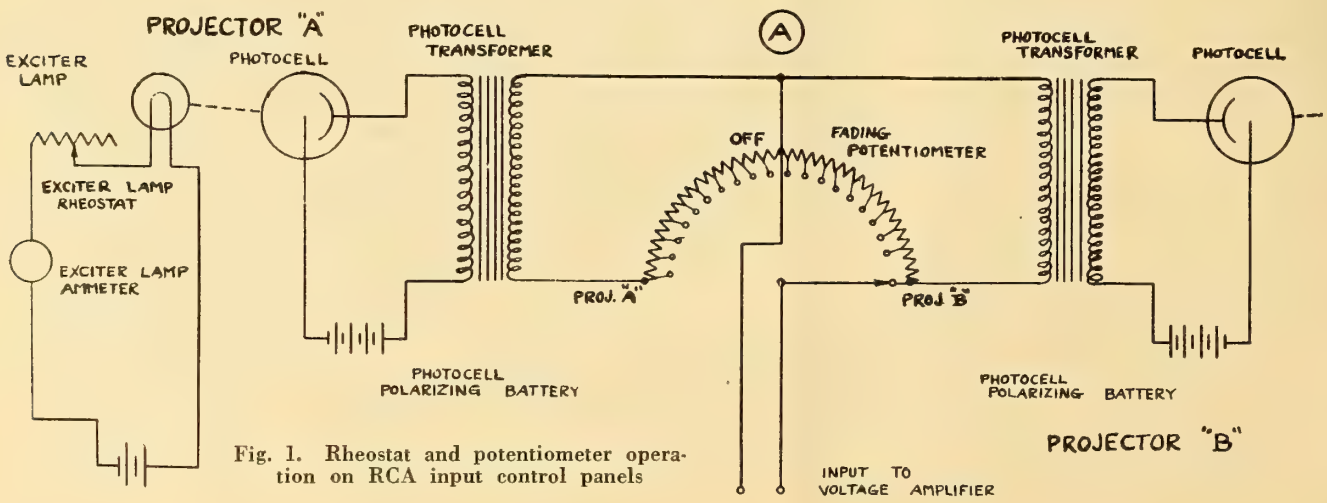
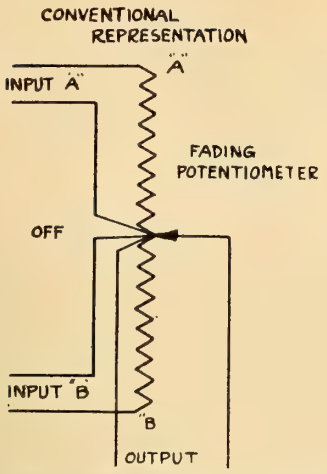


Fig. 1. Rheostat and potentiometer operation on RCA input control panels



the contact arm back and forth along the resistor, the amount of resistance in the exciter lamp circuit may be varied, thus varying in turn the exciter lamp current.

When the exciter lamp is first turned on, it will be noted that the ammeter needle will swing farther to the right than normal, and after a second will drop down to a more nearly correct value, when it may be adjusted to its proper value by means of the rheostat. This initial "flicker" is due to the fact that most metals increase in resistance as their temperature rises. As the exciter lamp heats up, the resistance of its filament increases and cuts down the current, in addition to the control afforded by the rheostat. This heating-up process takes only a short time.

Potentiometer Preferable

For very fine and smooth control of voltage over a wide range, a potentiometer is a much better instrument than a rheostat. In appearance many potentiometers are very similar to the rheostat, described above, the difference being only in their connections. The operation of a potentiometer may be likened to a gravity feed water system, from which different pressures are desired and are obtained by varying the height above ground from which the water is tapped off.

If a water-operated machine, the speed of which it is desired to change, was driven by water from a reservoir on the top of a hill, the speed of the water motor could be changed by mounting it on an elevator and carrying it up and down hill and attaching it to the pipe at different intervals, since various pressures could thus be obtained. For slow speeds the motor would be connected at the top of the incline. For high speed, the motor would be attached to the pipe line at the bottom of the hill. Of course, such a method of obtaining speed variations on motors is highly impracticable and foolish, but in electrical circuits such a method of obtaining a change of voltage or pressure is very desirable and convenient.

The volume control and fading potentiometer work on the principle stated above, and are constructed of a number of fixed resistor units connected in series. Connections are made between the resistor units, and are brought to the points of a tap-switch. (Fig. 2.) The switch sliding contact moves across the "points" and the voltage is controlled in "steps" in proportion to the resistance between taps.

Input Control

An input circuit, the voltage of which we desire to vary into our amplifier, is connected across the outside ends of the potentiometer. The output circuit is connected from one end of the potentiometer, and from the sliding contact. When the sliding contact arm is at the point of the potentiometer farthest from the other output connection a maximum voltage is obtained at the output circuit. As this arm is moved towards the end of the potentiometer at which the other output connection is made, the voltage is reduced until it is finally brought to so small a value that it is practically negligible.

At this point the output circuit is practically short-circuited, due to the fact that the sliding arm of the contact is resting immediately above the other output connection. To obtain a similar wide change in voltage by means of a rheostat, it would be necessary to use a very, very large amount of resistance which would be variable through an extremely wide range, and such a method is highly impracticable. Potentiometers are used where the range of voltage adjustment desired runs from a maximum value to almost zero.

The fading potentiometer used on RCA input control panels is, in effect, a double potentiometer. In other words, its effect is that of two potentiometers connected together, one being used to cut out the signal from one projector, while the second takes up where the first left off, and increases the signal from the second projector. The input from the two projectors have a common connection

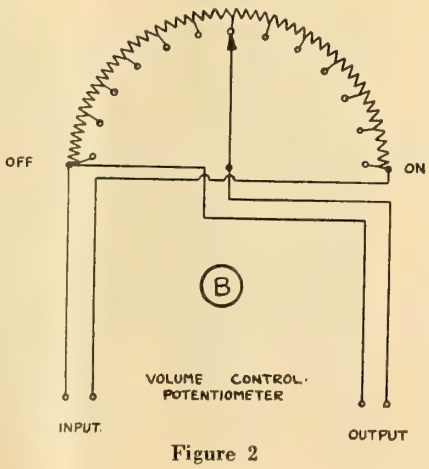
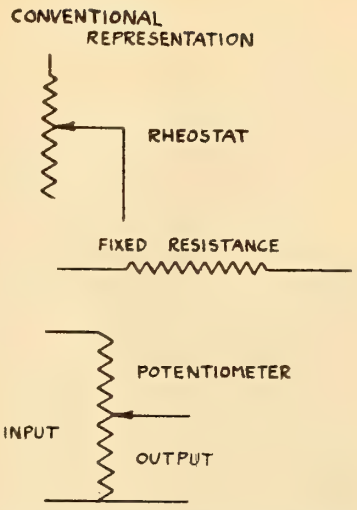


Figure 2



made to the center of a group of resistor units. The other connections from the outputs of the two projectors are individually connected on opposite ends of this group of resistors.

The input to the amplifier is taken off at the sliding contact and at the mid-connection of the potentiometer. Thus, when the resistor sliding contact is at the center of its swing, there will be no input to the amplifier. If it is on the extreme position to the right, one projector will be used and the other will be out of the circuit. When at the extreme left of the swing, the rheostat will cut out the first projector and bring in the second. (Fig. 1.)

Local 640 Anniversary

Local Union 640 of Nassau & Suffolk counties, N. Y., will play host at its first anniversary dinner to be given at Handel's Duck Inn on April 23rd at 12 midnight. Local 640 officers in charge of arrangements for the dinner are President Frank Cummings, Vice-President M. D. O'Brien, Secretary R. Titcomb, Treasurer D. Peshlan, and Business Representative George Leisser. Many large delegations from outside the 640 district will attend, including International Alliance officials and Local Union representatives.

Show Sound Picture Process

"Finding His Voice," Western Electric's 1,000-foot film which is the first sound picture telling how talking pictures are made, is completing its first Broadway showing, a week's run at the Capitol. The audience reaction has justified the feeling that Broadway patrons are intensely interested in seeing and hearing how films get their voice.

"Finding His Voice" explains in cartoon style the intricacies of talking picture production, illustrated in a way to make the process clear to any layman. It is being distributed throughout the country to theatres equipped with the Western Electric Sound System.

Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

TROUBLES in amplifiers can often be located by making a number of preliminary tests. Transformers and coils can be tested for continuity by means of a headset and a small C-battery, connected in series. A click should be obtained when the tester tips are held across the terminals of the ends of the primary winding or secondary winding of input and output transformers. The absence of a click indicates an open circuit, which may be the seat of the trouble. All resistance devices, whether fixed or variable should show continuity of the resistance element. There should be no click when the testing tips are applied across the primary and secondary windings of a transformer.

Condensers can be tested by touching the testing tips to the terminals. Usually there is a click, resulting from the current rush, but there should be no more clicks when the testing tips are repeatedly touched to the same terminals. Both fixed and variable condensers are tested in the same way. Care must be taken to see that there is not a shunt circuit around the condenser through which the current can pass, which would result in a faulty test.

Most Common Troubles

The next step in preliminary testing is to look over the wiring connections to see if any of the terminal connections are loose, or if any two wires, previously connected have come apart, which sometimes results from poorly soldered joints. The most frequent disorders occurring in Western Electric amplifiers are open and short circuits in the secondary windings of input-transformers, also short circuits between the plates of condensers, faulty resistors, and loose connections.

The filament circuit of an amplifier is the network of wires that supplies the current for lighting the tubes and all the instruments which are connected in a series with these lines, such as switches, rheostats and resistors, are also included in the filament circuit. When the filament circuit is supplied with the necessary filament current at the binding posts on the amplifier or at the cable ends, and the tubes nevertheless fail to light, an open-circuited condition is evident, which can readily be detected by the headset tester: clicks indicate continuity of a conductor between the points, where the testing tips are applied. As soon as there is an absence of click between points which should be connected, the trouble has been found.

The places in which to look for open circuits are switches, rheostats and resistors. Apply the testing tips to both terminals of these devices when they are in position. When batteries are used for the filament circuit—if a short circuit develops, it will quickly run down the batteries.

Open Circuits

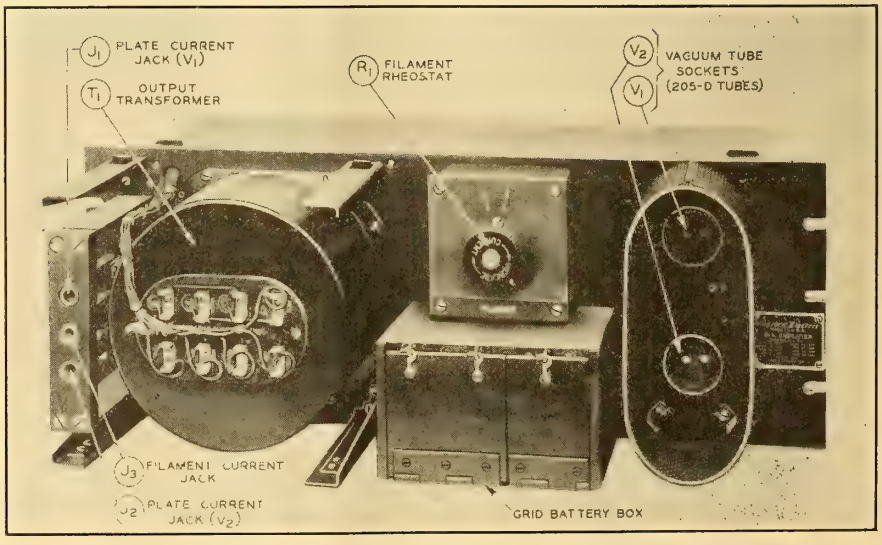
Open circuits often occur in rheostats. This trouble can easily be detected by means of a continuity test with the headset and C-battery, the testing tips being held to the terminals. Rheostats may be open-circuited owing to a loose slider. Sometimes the shaft of the rheostat may have developed some play, or the whole assembly may have become loose on account of handling or constant vibration. The slider may also have been accidentally bent, which usually can readily be remedied by bending it back to its normal position.

In some cases after a rheostat has been in use for some time, the resistance wire may become coated with an oxide, caused by the heating of the wire. The first symptom of this trouble is a scratchy sound when the slider is rotated over the wire. In extreme cases, parts of the winding may be covered with so much oxide that no current will flow from this section of the winding to the contacting slider. To prevent this trouble, take a rag, moisten with very light oil and rub off the oxide from the winding along the contact path, being careful not to bend the slider. Wipe off the oil afterward with a cloth moistened with alcohol. When replacing a rheostat, be sure to get one of the same resistance value as the defective one to be replaced.

As the grid element of an amplifier vacuum tube is extremely sensitive and controls the action of the tube by letting more or less plate current pass in synchronism with the fluctuations of voltage applied to it, the grid circuits must be in good condition if satisfactory results are expected. The most common troubles encountered in grid circuits are high-resistance joints and open circuits, faulty connections, short circuits, grounds, induction troubles and correct values of grid leak and condenser, and faulty by-pass condensers.

High-resistance joints and open circuits may be found in the wiring, owing to a broken joint, which has been poorly soldered, a flux-insulated or corroded joint. Such defects can sometimes be found by testing with a headset and a C-battery. "Cold" soldered joints which can be detected by their rough and ragged appearance, should be re-soldered. The soldering iron should be kept on the joint until all the solder is melted and has a smooth surface as soon as the iron is removed. Flux-insulated joints can readily be wiped clean with a rag saturated in alcohol. The practice of wiping soldered connections in this way should be observed when any work of this kind is done.

High resistance caused by corrosion may result if all the flux is not wiped off, for most flux contains a certain amount of acid, which eats down into the wire and leaves an insulating crust. Acid flux should never be used on amplifier circuit connections. Uncontrollable whistling and howling in



W. E. 9-A amplifier, front view cover removed

amplifiers is often caused by pick-up on grid leaks. All electrical conductors through which pulsating currents flow, set up an electro-magnetic field around them, the lines of force of which are at right angles to the conductor. This field induces currents in other wires running through it.

Tube Troubles

After an amplifier has been in use for some time, trouble may be experienced from faulty contacts between the tube tips and socket prongs. Crackling and frying noises, reduced volume, and sometimes total inaudibility may result. The reason for the trouble may be the gradual formation of corrosion on the socket prongs and on the tube tips, which makes a high-resistance joint, or the trouble may be due to the socket prongs being bent down too far. The latter is often the case. Frequent changing of tubes in sockets is also responsible for this trouble.

The prongs can be lifted up again with the aid of an ordinary button-hook. Another reason for a loose socket prong is the loosening of the screw-and-nut assembly, which holds the socket prong in place. Some types of sockets have prongs which make a "wipe" contact on the tube tips, when the tube is removed and oftentimes, the prongs of the socket are so tight that it pulls the soldered ends of the tube tips. The tension of socket prongs should be adjusted carefully. When adjusting socket prongs, be positive that the filament and plate circuits are disconnected.

Microphonic Tubes

Most every projectionist has run across a microphonic tube, which could not be used in the photo electric amplifier. A microphonic tube usually produces a howling noise, which increases in volume and rises in pitch, making reproduction impossible. Sometimes the microphonic noise is caused by vibration and sometimes there seems to be no external source of vibration at all, and the tube just starts to produce the noise, seemingly of its own accord.

The quality of each tube is slightly different from that of another, and one tube may therefore be much more microphonic than another. A variation of uniformity can naturally be expected when tubes are manufactured by the thousands in rapid quantity production. Small tubes have a greater tendency toward being microphonic than large tubes. Sometimes the trouble can be cured by merely "switching" the tubes in the p. e. c. amplifier. Do not throw Western Electric 239-A vacuum tubes away, which are microphonic, as they may be used in the 41-A amplifier.

New Type Exciting Lamp

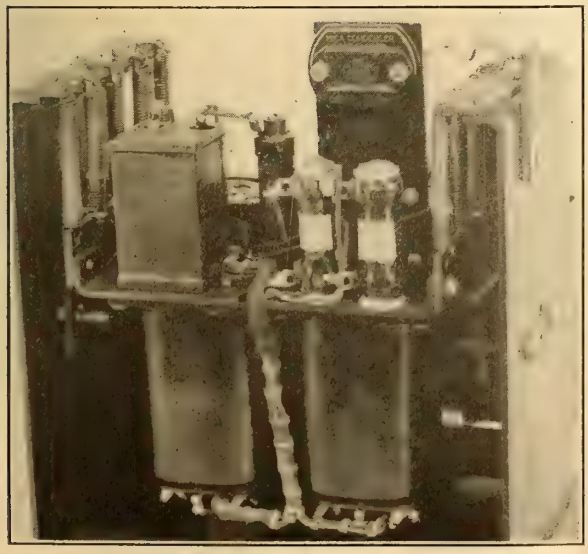
The newer type exciting lamps have been supplied to many theatres. It will be found that these lamps have a shorter filament than those supplied by ERPI. Many projectionists and engineers have rejected these lamps, because they were thought to be inferior without even giving them a test. These new lamps do not have the ERPI stamping KS-6243—however, this is no reason for rejecting them.

The shorter filament lamp is not detrimental to Movietone sound reproduction. It is found with the shorter filament more concentration of light is obtained at the sound track, which naturally increases volume, and makes it possible to run at a lower fader setting. With the longer filament lamp, such as we have been using during the past, a certain amount of light is spilled at the sides of the slit. The theory of the Movietone optical system is similar to the projector optical system, and it requires careful study to obtain good results. When a new shipment of exciting lamps arrives test them properly and do not reject them because of the short filament.

Lamp Discoloration

Discoloration usually appears first at the top of the exciting lamp, which does not obstruct the intensity of the filament image. When checking a lamp for discoloration, remove the lamp holder from the exciting lamp housing and look at the lamp against a white background, this will give you positive proof of discoloration at the top and walls of the globe. Make sure the glass is perfectly clear and clean in front of the filament.

Again, warning should be issued against lamps with saggy filaments. When the filament becomes slightly saggy, discard the lamp. Inspect sound lamps daily, and be assured againt loss in volume and injury to sound film reproduction.



Western Electric 49-A amplifier. The filament rheostat which controls the vacuum tube filaments of this amplifier should not be varied during operation, as crackling and popping noises will result. The indicated valve should always be adjusted before starting projector.

THE first Western Electric sound installations used the 9-A amplifier with the 2-S, 2-SX and 2-D equipments. This power amplifier is used to raise the output of the 8-B speech amplifier to a higher energy level. It has a single stage of push-pull amplification, which uses two 205-type Western Electric vacuum tubes and works from the output of the 8-B amplifier. The maximum gain of this amplifier is 16 TU. The gain cannot be controlled. The filament current of 3.1 amps is supplied by a 12-volt battery. At the back of this amplifier, under the removable cover, is a 5-amp fuse which protects the filament circuit. The plate potential is 350 volts, which is supplied from a battery source. In many theatres I have replaced the "B" batteries with a motor generator set, which operates very efficiently and supplies a very consistent steady flow of D. C. voltage.

At the back of this amplifier will be found a .25-ampere glass tube fuse, which protects the plate circuit. Five small dry cell batteries are used for the negative grid voltage, which supplies 22½ volts. These batteries are installed in a box on the front of the amplifier, similar to that of the 8-B amplifier.

Faulty Grid Batteries

When these small dry batteries are used for grid voltage, they should be inspected quite frequently for loose terminal clips and poor contacts, as I have found on several occasions that a faulty grid battery was the cause of a peculiar squeal in the reproduction. At the top edge of the grid battery box will be found contact studs, which are placed here so that the voltage of the grid batteries can be measured. The total output of the 9-A amplifier is 1.360 watts.

The old 2-S and 2-SX equipments have two 9-A amplifiers. These amplifiers are connected to the output control panel through the switching panel. This panel has a switch called the amplifier key. For regular running, this key is set in the central position, marked "R;" this connects both 9-A amplifiers to the output control panel. In the left-hand position, marked "E1", one of the 9-A amplifiers is cut out, the other remaining connected to the output control panel. In the right-hand position, marked

(*Continued on page* 21)

As The EDITOR *Sees* IT

¶ *Wide Film Standardization*

OF particular interest to the technical end of the motion picture industry is the news that a compromise has been reached among representatives of the three companies who are sponsoring wide film systems with the result that the new standard wide film size will probably be 68 millimeters. Whether it be 65, 68, or 70 millimeters is not important; what is important is the fact that picture executives have acted to prevent a technical debacle. Paramount and Radio now put forth 65 millimeters as standard, with Grandeur having actually gone into production on a 70 millimeter basis. It is not unlikely that after the conferences between these companies are over 68 millimeters will have been agreed upon as standard.

It is no secret that the producers were forced to action in this matter by the insistence of their respective technical staffs who could easily visualize the troubles in store for the industry had various sizes of wide film been offered for distribution. To our knowledge this is the first really important concession to the technical forces of the industry by picture executives, and the impending announcement of wide film standardization is indicative of the influence which is now being wielded by picture technicians. Sound pictures taught picture executives many things, not the least important of which was that technical errors and a certain contempt for the opinions of technical men can be very expensive.

Now that standardization of wide film has been reached, we look for much production activity on this new size. Technical directors and business executives of the various companies concerned with wide film are to be congratulated for their foresight and prompt action in this matter.

¶ *Important Advances in Television*

TELEVISION has made many strides forward within the past six months. This progress may not be apparent to the uninitiated, but those who are familiar with the art know that in the matter of equipment and in technique there have been many advances. Within the past month three television companies have sponsored successful demonstrations—successful, that is, in that what was attempted was accomplished. We do not mean to imply that television has "arrived," or that "television will be in every home this Fall," as was advertised by one indiscreet company. Progress there has been, however, and we look for a steady development of the art over a period of, say, five years rather than a mushroom growth.

Many long days of hard work confront television workers before their product may attain a definite commercial status. Serious workers in the art are agreed that television will require at least five more years of work before its commercial possibilities can be plumbed. The sponsors of television systems have evidently come to the conclusion that "wild" publicity stories on the wonders of television, while gaining the spotlight momentarily, in the long run will prove harmful. For this reason they are confining their press releases to statements of actual fact and work really accomplished. This is a good omen.

It might be well for those engaged in the amusement field to keep a "weather eye" peeled for developments in television. Progress in the art will be recorded in these columns from time to time and we hope that these reports will be of material help in charting the advances made.

¶ *Los Angeles I. A. Convention*

THE forthcoming International Alliance Convention in Los Angeles, June 2-5, will offer all Local Union delegates thereto an opportunity to perform a valuable service for their brother projectionists. When the Alliance met two years ago the sound picture situation was a bit unsettled and it naturally was a difficult task to promulgate rulings on various phases of this activity. But now the sound picture field is stabilized, insofar as labor is concerned, and the opportunity to define the various activities of organized labor in the field is at hand.

There has been a wide expansion of sound picture activities. No longer are sound pictures a medium for entertainment only. Those who are in a position best to know are looking toward the near future when motion pictures with sound will enjoy non-theatrical applications of so large a scope as to be difficult to definitely chart. Particularly active at present is the educational field, in which the arts and sciences are being taught to the youth of the country in a novel and highly interesting form. All branches of the motion picture industry will profit as a result of this expansion, and it is imperative that organized labor progress apace.

Among other important matters which will engage the attention of the delegates is the growing tendency on the part of municipal and state lawmaking bodies to legislate against the best interests of the craft. During the past year there have been introduced in various localities bills which were palpably against the best interests of the craft. Some of these bills died aborning, some were defeated after only the hardest struggles, and some were passed. In any event, it required constant watchfulness on the part of labor leaders everywhere to hold the reins tightly. Machinery for concerted action against such endeavors in future should be provided.

All in all, delegates to Los Angeles have an important obligation to discharge. The record of past International Alliance gatherings are the best possible indication that this obligation will be creditably discharged.

RCA Photophone

1st **To introduce the curved gate**
Insuring smooth reproduction, eliminating scratches, gear and sprocket tooth flutter and stoppage due to buckling of film.

1st **To adopt change-over switch**
For instantaneous changing from one projector to another. . . . .

1st **To employ Caesium photo-electric cell**
Insuring long life and dependability, quiet in operation and requiring no photo-electric cell amplifier mounted on projector.

1st **To utilize dynamic cone loud speaker, *with directional baffles.*** Establishing unsurpassed fidelity of sound reproduction and insuring effective sound distribution to all parts of the theatre. Also eliminating stage batteries for loud speaker field excitation.

1st **To offer motor generator operation for small theatres**
Eliminating all storage batteries and battery charging equipment.

1st **To abandon variable speed control**
Thereby decreasing cost, simplifying operation and insuring projection at proper speed. . .

1st **To utilize standard Radiotron tubes**
A tube superior to all at a low cost.

1st

and **First** to make it possible for the small theatre owner to install the finest sound equipment at a price he can afford to pay.

1st In Box Office Value Because It is 1st in Sound Satisfaction!

Today, more than ever before, the patron of the motion picture theatre demands "sound satisfaction," and the installation of RCA Photophone sound reproducing equipment is the exhibitor's best guarantee of sound reproduction of the highest quality.

The trend nationally and internationally is toward RCA Photophone!

Back of every installation made by RCA Photophone, Inc., lies the unmatched prestige of the world's foremost electrical engineering organizations and their strength and stability are reflected in the performance of RCA Photophone sound reproducing equipment.



SMALL THEATRE TYPE A. C. EQUIPMENT FOR SIMPLEX PROJECTORS

SOUND ON FILM AND DISC

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Efficient Sound Reproduction

(*Continued from page* 17)

"E2," the second 9-A is cut out and the first one remains connected. These arrangements are emergency set-ups for use in case of trouble with one 9-A amplifier.

When two 9-A amplifiers are used together, the input impedance is 4000 ohms. If one 9-A amplifier is used, resistances are placed across the primary of the input transformer to make the input impedance 500 ohms. The two 205-type vacuum tubes have their filaments connected in parallel. The indicated value of these filaments is 3.1 amps. The smaller plug and cord connected to the 514-A meter panel is inserted in the center jack of the 9-A amplifier, while checking the filament current. An adjustable rheostat on the 9-A amplifier makes it possible to adjust the filament current to the proper value. The larger of the two plugs connected to the 514-A meter panel is for the purpose of checking the plate current value. The plate current in each tube should be 30 plus or minus 10 milliamperes.

Checking Projector Speed

It is necessary that the speed of each projector be checked daily. If above or below 90 revolutions per minute, it will spoil the quality of reproduction. During my visit to one theatre, I was watching the picture and listening to the sound. When a changeover was made, I immediately noticed a change in the reproduction. I visited the projection room and checked the speed of the projector and found that it was running at 80 R.P.M. I checked over the equipment and found that one of the 205-D vacuum tubes in the motor control box was the cause of the trouble and upon replacing same brought the projector up to the proper speed.

Sometimes owing to line voltage conditions, the 708-A control cabinet milliammeter does not read within the range of 20 to 30 mills. A high reading on the milliammeter is many times caused by an excessive load on the motor. When the reading is high, check the projector mechanism bearings and all working parts, as some bearing may need lubrication. When starting up a cold motor and projector, the temporary stiffness of the bearings may cause the current reading to be momentarily high.

Sound Film Splices

Many projectionists are still using the old method of painting out splices on film bearing photographic sound records with black lacquer and many are not using anything. Any irregularity in the sound track is abrupt and causes a sudden change in the light transmitted by the film passing the light. It is essential to gradually mask off the entire width of the sound record, where a splice is made, otherwise, a foreign noise will be heard when this part of the record is reproduced in a theatre.

Applying lacquer with a brush on film and waiting for it to dry is a very slow method and oftentimes the results are very unsatisfactory. A very simple method has been adopted by many projectionists. A small piece of thin black film is cut to the desired shape of masking off the sound track gradually and applied over the patch after the splice has been made. A small quantity of these patches if kept on hand will assist the projectionist to splice a broken film sound record quickly without introducing any noise into the record.

On many occasions I have been called by the manager and informed that the reproduction in his theatre was very poor. Upon investigation, I most always find that the manager has room for complaint.

The public cannot be kidded into the fact that the reproduction in any theatre is good if it is poor. Those days have gone. Dialogue must be clear, clean cut and audible. Poor sound is not always the fault of the auditorium acoustics or the studio recording. Your sound equipment must be capable of producing good reproduction with high and low frequencies undistorted. There are many things, which must receive care and attention to have good sound reproduction. Lack of synchronism with Movietone subjects is inexcusable. If projectionists thread the Movietone proectors carelessly lack of synchronism will be the result.

Closer Screen Attention

Projectionists must watch the screen more closely. They must listen to the sound and be able to detect lack of synchronism. The monitor horn in the projection room is not installed for amusement. Controlling the volume in the auditorium is very important. The manager is entirely responsible for the volume control. I realize that we cannot please all patrons as to the amount of volume required, as some persons hear much better than others—however, checking over the complaints we find it is most always the fault of the observer in the audience, who left his post to go somewhere and left the volume to take care of itself for a few minutes. The recording is coming through much better and a certain level is maintained; however, there are a few studios whose productions are worse than ever. Regardless of how many patrons are in the auditorium, try to please them to the best of your ability and keep the volume at a certain level, so that your audience will go out well pleased.



W. E. 1-A Photoelectric cell

Your success with sound pictures depends entirely on the quality of reproduction. Regardless of the excellence of the subject or feature, its success from a box office standpoint depends on the quality and correct volume of the accompanying sound, be it voice or instrumental music.

Photoelectric Cells

The photoelectric cell is the eye of sound on film reproduction. Western Electric employs the 1-A and 2-A photoelectric cells in their sound projector systems. It is imperative that the cell be housed in a light-proof compartment, with an opening, so that the window of the cell can collect the light impulses from the sound track, without other interfering light rays. The Western Electric universal base equipment is provided with a separate cell compartment. With the first W. E. sound proector installations, the photoelectric cell was installed inside the photoelectric cell amplifier compartment.

The new photoelectric cell compartment is provided with a positive binding post insert and set screw. A round opening was left in the casting for the purpose of tightening this set screw. This opening is in such a position that it accepts a very small amount of light reflection from the projector mechanism revolving shutter. This light reflection produces a motorboating sound, which is very detrimental to sound films reproduction. A small cork can be placed in this opening, which eliminates the fluctuating light reflection from entering the photoelectric cell compartment.

I visited a theatre recently and was watching the picture, and listening to the sound of a movietone subject, when all at once a loud 60-cycle hum was perceptible in the reproduction. I visited the projection room, which had the old style Movietone attachments, and found one of the projectionists with a work lamp, inspecting the p. e. c. amplifier, where the photoelectric cell was installed and in operation. He was unaware of the fact that the photoelectric cell was capable of picking up frequencies

from a light source and yet he was quite familiar with the W. E. sound reproduction system.

The photoelectric cell is very sensitive. Instead of being sensitive to sound, it is sensitive to light, and light variations falling upon a photoelectric cell cause it to affect the current in exact proportion to the intensity of the light. A weak light will cause but a small change in current and a stronger light a greater change. We may regard the photoelectric cell as a perfect insulator in the dark and a partial conductor when exposed to light. The cell, however, does not conduct a great amount of current even when it is subjected to powerful beams of light. At best, only a current of a few microamperes will pass through them.

Types of Cells

There are two types of photoelectric cells; one the gaseous type and the other the high-vacuum type. The W. E. cells are the gaseous type. In the gaseous type, there is admitted to the cell during its construction and after a high vacuum has been created, a very small amount of one of the rare gases, such as argon, neon or helium. Such gases, when subjected to the bombardment of electrons that are released when the cell is struck with light, become conductive to a degree depending upon the intensity of the light. Potassium hydride is one of the extremely photo-sensitive combinations, which is deposited upon the inside of the photoelectric cell, which is connected to the negative terminal of the cell.

The other electrode of the cell takes the form of a grid anode which may be made up of either a single loop of fine wire, or a thin metal gauze suitably suspended and supported, which is connected to the positive terminal of the cell. When electrons are emitted from the cell surface, these electrons are drawn toward the anode conductor due to the positive potential, which is maintained by a battery.

Selenium Cells

While discussing the photoelectric cell, I might mention the Selenium cell. We must not make the mistake of confusing selenium cells with photoelectric cells, inasmuch as we are dealing with two different effects, although it may be said, broadly speaking, that both types of cells operate on a photoelectric principle if we take "photoelectric" to mean the control of current by light.

In the photoelectric cell we are dealing with pure electronic emission surfaces. In the selenium cell, on the other hand, we are dealing with changes in ohmic resistance brought about by light. The cost of selenium cells as compared with photoelectric cells is much less.

Selenium cells vary considerably in their quality. In every type of selenium cell there is always the variable factor, which makes it very difficult to use them in film reproduction. However, they are being used at the present time.

Every selenium cell has what is known as lag or inertia. The lag is the time that expires between the instant that the light falls upon the cell and the instant that the resistance of the cell drops in response to the light. This lag is controllable to a certain degree by the design of the cell itself and the method used in preparing the selenium. As a general rule, we might say that the higher the resistance of a cell, the less its inertia. It may further be claimed that the higher its resistance, the greater the ratio of sensitivity. This inertia not only opposes the drop in resistance when the cell is illuminated, but it also opposes to a much greater degree the return to normal resistance. This inertia effect can be reduced still further by enclosing the cell in exhausted glass tubes. This not only reduces the lag or inertia, but also adds considerable to the life of the cell. There are, at least, twenty-five different types of selenium cells, which are a result of the research work of many different experimenters.

Selenium Supply

Selenium is found among the rare minerals, and is related to both sulphur and tellurium in the periodic table. The source of the metal in this country is in the anode muds of our electrolytic copper refineries. Only a few tons of it are produced each year. In its raw, untreated state it shows a resistance as great as that of copper. When properly annealed by keeping it at a temperature just below its melting point for a long period of time and permitting it to cool slightly, it assumes a crystalline condition and in this condition its electrical resistance is considerably reduced and it at the same time becomes susceptible to changes induced by light.

P. E. C. Amplifier

As explained before, the photoelectric cell circuit is inherently one of high impedance. In spite of precautions, many projectionists continue to vary the photoelectric cell amplifier filament rheostat while the Movietone attachment is in operation, which results in popping and crackling noises which are often heard from the horns along with other reproduction. The current value of the p. e. c. amplifier tube filaments should always be set before starting the projector. Many projectionists, while running Movietone productions, will pull the switch controlling the p. e. c. amplifier and exciting lamp after making a changeover. This is not a good practice.

Both photoelectric cell amplifier and exciting lamp currents come from the same source of battery supply. When the values are set, and the Movietone projector started, any variation in this circuit will be perceptible in the reproduction—therefore, it is advisable to always leave the circuit completed on the projector not in operation. However, the current values may be reduced. Many theatres, running continuously, will object to this method of operation, because of the drain on the "F" batteries. Every theatre, where W. E. equipment is installed, has two sets of "F" batteries, and therefore one set should always be fully charged while the other one is in use.

It is imperative that Fader contacts be cleaned quite frequently. I have found many faders with contacts badly corroded and very dirty. When Fader contacts become dirty, noises will be perceptible on changeovers, and when increasing or decreasing the volume. Fader contacts should be cleaned with a soft rag dampened with carbona and after cleaning they should be polished with embossed paper and a very small amount of vaseline applied to the contacts, which will help ease the operation and besides, will help to keep the contacts from becoming corroded. Never use rags for cleaning rheostats, switches or contacts or any sound equipment, unless the rag is absolutely free from lint. A small piece of lint catching between contacts will often prevent the circuit from being completed.

I. A. Convention Plans

Representatives of all affiliated local unions of the International Alliance will convene in Los Angeles, California, on Monday, June 2. Eastern delegates to the convention will leave for the West Coast not later than May 28th, and many parties will leave even earlier. It is not unlikely that a special train will be made up out of New York City to accomodate New York State, New Jersey, and New England delegates.

Los Angeles, convention city, is the home of five local unions chartered by the International Alliance, namely, L. U. 150, projectionists; No. 33, stagehands; No. 659, cameramen; No. 683, laboratory workers, and No. 37, studio stage mechanics. Nos. 33 and 150 meet in Los Angeles, and the other three in Hollywood. These five local unions have a total membership of more than 3,700.

West Coast Local Unions, particularly the above-named five, are highly pleased at the choice of Los Angeles as the convention city, and they are making elaborate preparations to entertain visiting delegates.

Ontario Safety Campaign

A campaign has been launched in Ontario for the inspection of all theaters with a view to removing risks of fire and panic. Hon. Dr. J. D. Monteith, Provincial Treasurer, is behind the drive and expects to have all of the 428 houses in Ontario gone over within the next 12 months.

Dry Cell Batteries for Projection Work

By W. B. SCHULTE*

A DRY cell battery is an electro-chemical unit which produces electrical energy from chemical reactions which take place within itself. It cannot be recharged similarly to a storage battery. A dry cell consists of a zinc container into which is packed a carbon rod surrounded by an oxygen-carrying compound, a manganese dioxide ore, called a *depolarizer*. This depolarizer tends to maintain the current at a maximum value and aids the cell to recuperate and quickly recover its normal condition after periods of work. The open circuit voltage of a dry cell is about 1½ volts, irrespective of its size. The momentary current that a dry cell can fill depends upon its resistance, and ranges from 5 amperes for this very small cell, the size of a thumb, to as much as 50 amperes for the large 2½-inch by 6-inch size which is used on door bells, or as the radio "A" battery.

The electrical capacity of a cell is more than proportional to its size. The larger the cell the greater the ampere-hour capacity; likewise the cost increases with size, but not at as rapid a rate. Where high voltages are necessary a number of cells are soldered together in series to produce the required value. If large cells are used the bulk will be great, and the electrical capacity and cost high. With smaller cells the same voltage can be obtained in a smaller volume but with a lower electrical capacity and smaller cost. It is impossible to establish any rule by which battery size can be determined, as there are so many factors which affect the choice. For example, the space or weight limitations, the current necessary and the cost of installation.

General Characteristics

This discussion will touch on some of these matters; and from the experience of the dry cell manufacturers, call attention to those factors that the motion picture engineers should consider in choosing a dry cell battery for their units.

The characteristics of dry cell batteries, most generally discussed, are capacity, shelf-life, and recuperation.

Capacity is the electrical energy that can be obtained from a cell or battery. It can be measured as service hours or ampere hours when discharged under standard conditions to a definite voltage. In comparing two batteries, therefore, one must be sure that all of the test conditions are standard or at least comparable. For every size of dry cell there is a value of current where its capacity is the greatest.

Shelf-life is that quality of a dry cell which permits it to stand on a shelf for a long time without losing an appreciable quantity of its electrical capacity. In general a large cell has a better shelf-life than a small one, but it is much affected by the purity of materials and the methods of manufacture.

Recuperation is the measure of the ability which the cell has to return to its previous state of activity during an interval of rest following a period of work. As a cell is discharged, its working voltage gradually lowers. Periods of rest allow this voltage to regain a large portion of the previous value. Naturally a good recuperation is desired in a dry cell battery.

Testing

The only way by which the capacity of a battery can be measured is to discharge it. This, of course, ruins the battery for further use. Voltage and amperage measurements can be made on a battery, but they must be interpreted and weighed against the values obtained from similar batteries of the same manufacture. Six-inch dry cells, when sold over the counter, are usually flashed on a pocket ammeter which merely indicates that the cell has or has not a low resistance. The short circuit flash of a cell is no true measure of its available capacity. To a buyer, or an engineer who is using the same batteries every day, the flash may indicate a variation from an average.

The voltage test is a reliable, practical test that can be made, but it likewise must be used with discretion. To rate a battery by voltage it is necessary to know the number of cells that are contained in it so that the engineer can determine how closely the battery tests to the usual 1½ volts per cell. Unless high resistance voltmeters are used, there will be a variation in indicated voltage between batteries of different sized cells, which usually shows the large and low resistance cells as having a higher voltage.

In an installation of two or more batteries it would always be worthwhile to make a voltage test on each battery at the time of installation and record these data. At frequent intervals other voltage measurements should be made with the same voltmeter and the voltage recorded. By keeping records of each battery in this manner the engineer or projectionist can easily tell if his batteries are falling uniformly. If there is a non-uniformity of voltage drop with respect to time, it will indicate that certain of the batteries are below average and should probably be replaced before the others.

The cut-off voltage is determined, of course, by the chacteristics of the operating circuit, and the projectionist can determine this for his own information by making a measurement of it when the batteries are being replaced. The open circuit voltage of the batteries, when they are replaced, might be noted, and on subsequent battery installation this figure will be of help in determining the condition of the batteries. It is impossible to say what the open circuit voltage of a usable battery will be, but it is generally higher than 1¼ volts. In other words, the open circuit voltage range of a "B" battery, between the time it is installed, and when it is discarded, is only from 1½ to 1¼ volts.

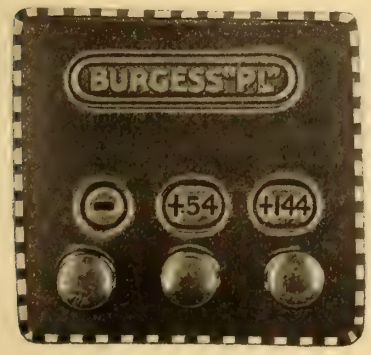
Cut-Off Voltages

When a cell is discharged, the working voltage drops rapidly at first. Then it slows down to a constant rate, but as the end is reached, it again



Cylindrical battery "stick" with outer wrapper slit to show position and method of assembly of the cells

* Burgess Battery Co., N. Y. S.M.P.E. Trans. Vol. XIII, No. 38.





Top view of batteries. Binding posts are provided for indicated voltage taps

drops rapidly. In comparing the capacities of cells it is very important that the cut-off voltages be defined; otherwise the capacity comparisons are not equitable.

Apparatus that uses dry cells should be designed to operate on as wide a range of voltage as is possible. The greatest battery efficiency is obtainable when the cut-off voltage is low, and for this reason the greatest battery economy is possible at a low cut-off voltage. For example, if a 45-volt battery is used on equipment that becomes inoperative as the battery drops to 40 volts, its service life might be 75 hours. If the equipment can be changed to work at only ten per cent lower voltage, or 35 volts, the batteries will deliver 260 hours of service or an increase of almost 250 per cent.

Mechanical Handling

If dry cell batteries are used in portable equipment or in places where they are suspended or held by straps, certain suggestions can be made regarding the installation.

Dry cell batteries are an assembly of units in an insulating container, and these containers are subject to size variation. For this reason they are not always of the exact size or shape, and allowance must be made for these discrepancies. Too often, equipment is designed around a battery that is not standard, and later, much trouble results in trying to get batteries that will fit into the places allowed for them. Any battery manufacturer can give the specifications of sizes for standard batteries which will usually accommodate those of other manufacture.

Batteries must not be strapped into position under excessive pressure. While they appear to be solid and substantial, a continual pressure might in time crack the sealing wax or break an electrical connection inside of the battery. Metal straps with sponge rubber cushions make a satisfactory holding means for batteries.

Sometimes a bank of batteries is desired in a movable equipment. If possible, this should be so designed that the batteries can be assembled, fastened and electrically connected in a nonconducting container, which in turn is placed in the movable equipment. By having the batteries in a replaceable container of this kind they can be taken into the laboratory and tested with proper instruments. Furthermore, a spare container with batteries can be assembled at leisure and quickly exchanged for one that has been in use.

Temperature

High temperatures result in a drying out of the chemicals in a battery and therefore decreases its shelf-life. The energy obtainable from a battery is greater if the battery is kept warm, because its resistance decreases. Experience shows, however, that batteries should not be stored or used at temperatures much above usual room temperatures. If the projection room is normally very warm, the shelf-life of the batteries in it will be shortened.

The cold increases the resistance of batteries and lowers the flash. Dry cell batteries have been used in Arctic and Antarctic conditions where they were insulated by heat insulators and found to work satisfactorily. Unless the current drain from them is high, the normal cold temperatures that would be experienced in sound projection would have no influence on them. If dry cell batteries are used in motor trucks, and should stand at freezing temperatures for several days at a stretch, it is expected that they would not operate as efficiently as if the trucks were housed in a warm garage during rest periods.

Insulation

Because of the high voltages that are sometimes used, dry cell batteries should be mounted in insulated cabinets. This will prevent set currents from flowing through the containers of the batteries and producing voltage fluctuations and perhaps noise. Batteries should be spaced with air insulation between them whenever possible, and if not in an insulated cabinet, they should be mounted on strips of paraffined cardboard or wood to allow some circulation of air around them. Moisture or steam should be avoided. Where they are used out of doors and subject to temperature changes, the connection should be made so that if there is any precipitation of moisture on the surface of the batteries, it will not cause a circuit between terminals.

High Voltage Batteries

Eight or ten years ago attempts were made to use high voltage batteries on the "B" circuit of broadcast receivers. They were not successful, with the result that radio engineers standardized on a 45-volt unit which contained thirty dry cells. Receivers and vacuum tubes were designed to use these batteries or multiples thereof, such as 90 or 135 volts.

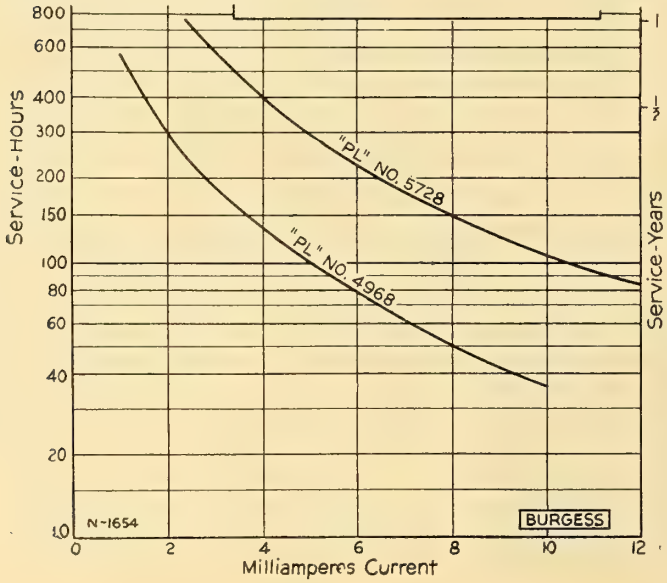
Photoelectric cells require higher voltages and photo engineers began combining units of 45-volt "B" batteries to supply their high voltage cells. As the currents that these cells draw are small, the smallest "B" batteries could be used. Battery makers thought they had gained enough information during the past years to enable them to assemble a satisfactory higher voltage unit of small dry cells. This was done; but it was felt that there was a danger in calling such a high voltage battery a "B" battery, and they were therefore termed "Potential" or "PL" batteries. These batteries, as they contain the smallest sizes of dry cells, should be considered as being a source of potential rather than as a generator of current. In exceptional cases, medium currents can be drawn from them, but it should always be under 5 mils.

These batteries have been used in a number of places in the motion picture field, because perhaps of their comparatively light weight and convenience.

The cells are cylindrical cells that have been double tested after aging. They are assembled in tubes of insulating paper and soldered together in series. To minimize current losses between adjacent cells, the connections are made to give the smallest voltage between them and a spacing of air insulation. As long as the batteries are kept dry and there is no moisture in them at the start, the air spacings between sticks gives the best possible electrical insulation.

These single-unit, high potential batteries are convenient for use in portable amplifier units, especially with condenser microphones. For portable recorders, where compactness and a minimum of electrical connections are desired, they will supply the various high voltages.

In film sound projecting equipment, standard 45-volt large size "B"



A continuous discharge of a fresh battery gives an indication of the amount of service which may be expected from it. This curve gives this data with approximately the same load per cell in each of the two batteries.

batteries are being made use of, because the current drains are comparatively high. These batteries, furthermore, are easily obtainable at reasonable prices; as they are not moved after installation, there is not much danger from the many connections necessary to wire them into the circuits.

On truck recorders the battery requirements are varied. Potential batteries can be used provided the current drain is not too high. At present, the tendency has been toward the use of a number of 45-volt "B" battery units, but these have their objections because the connections between them may work loose.

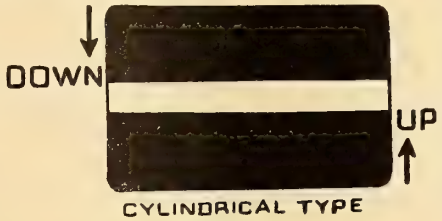
Horizontal Cylindrical Rear Shutter

SINCE the advent more than a year and a half ago of the Motiograph Model H mechanism with its horizontal cylindrical type of rear shutter, and in view of the fact that since then other manufacturers have adopted the idea of locating the mechanism shutter between the light source and the film, much controversy has arisen regarding the merits of "between the light source and the film" location and many requests have been made for data published some time ago on the horizontal cylindrical shutter of the Model "H" mechanism, the first to recognize and offer to the trade the now unquestionable and proven merit of this type of shutter.

Primarily, the Motiograph shutter was designed for the important function of eliminating the heat from the film. Heat on the film was fast becoming a serious problem. Constant demands for more light on the screen brought out more powerful illuminants including high intensity reflecting arcs, adding more heat on the film along with the increase in light. With the increased heat on the film came the attendant difficulties of warped and buckled film which caused still further difficulties in connection with the reproduction of sound from the film.

Three Distinct Purposes

The rear shutter on the Motiograph Model "H" mechanism is different from all other types of rear shutters. Its design represents the conclusion of a long series of experiments with rear shutters of every type in an endeavor to obtain a type which would function best to attain three distinct purposes: To eliminate most efficiently the greatest possible amount of heat from the film; to provide a means of cooling the metal parts of



CYLINDRICAL TYPE
Figure 3

the projector adjacent to the film aperture, and to provide as well, if possible, an increase in screen illumination over the former type of shutter in front of the lens.

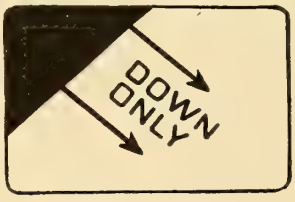
The final selection as a result of these experiments was the now well-known horizontal cylindrical shutter as pictured in Fig. 1. The shutter is positioned between the light source and film being mounted in a cast aluminum housing and rotating on ball bearings. Its action in intercepting the light beam and incidentally the heat was found by actual test to eliminate 62½ per cent of the heat from the film. In this test, temperatures were recorded with approved electric recording instruments of actual heat at the film position.

First, tests were conducted to determine the amount of heat on the film with a mechanism using the old type front shutter. Then with the same illuminant operated at exactly the same amperage the test was conducted with the Model "H" mechanism with the horizontal cylindrical shutter. It is interesting to note that a small variation in heat on the film was recorded at different speeds with the horizontal shutter positioned between the light source and film, whereas the heat on the film with the old type front shutter was, of course, constant at all speeds. The result of the tests showed heat on the film with the old type shutter at 1,486 degrees whereas the average taken of the different readings at different speeds showed the horizontal shutter reduced the heat on the film to 922 degrees less, or 564 degrees, as against 1,486 degrees, or 62½ per cent.

Aperture and Film Heat

This efficiency in eliminating the heat from the film is due to the action of the two vanes or blades of the horizontal shutter which are so arranged that the light beam is cut off in a horizontal plane from top and bottom simultaneously during the full film movement period, and again during what might be termed the flicker interception at that period when the film is stationary before the aperture. Thus it will be seen that the heat from the beam is prevented from reaching the film during the entire period of film movement and again during a portion of the time while the film is at rest. It being allowed to reach the film only at two short intervals, once when the film has come to a complete stop before the aperture and again after the flicker interception and until the film starts in motion again.

The second purpose of reducing the heat of the metal parts of the projector adjacent to and including the aperture is accomplished by a unique construction of the horizontal shutter itself and the construction of its



DISC TYPE
Figure 4

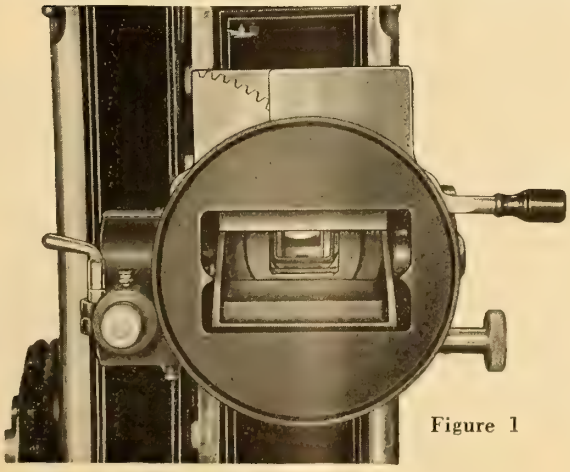
housing. It is well to remember that there is a distinct difference between the terms "heat at the aperture" and "heat on the film." By "heat at the aperture" is meant the heat on the aperture plate itself and the adjacent metal parts whereas "heat on the film" is the actual heat applied to the film.

Reference to Fig. 2 will show that the design of the rotating shutter is such that its ends are angled similar to the blades of a fan but each end of a different pitch; in addition are shown air disseminating vanes, all of which are designed to function in connection with the shutter housing to provide a forced air circulation for cooling of the aperture and the adjacent metal parts.

Forced Air Circulation

This forced air circulation does not *blow air on the film* since any such air blown on the film would be drawn through the heated light beam; it has, in fact, an exact opposite effect. The shutter housing is attached to the film gate in a manner to provide air ports between it and the film gate. In the film gate itself are other air ports. The construction of the hori-

Motiograph horizontal cylindrical shutter, used on Model "H"


Figure 1

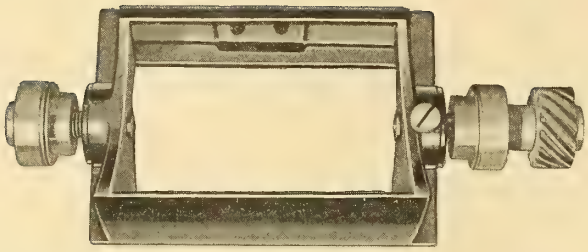


Figure 2

zontal shutter with its fan ends and air disseminators in conjunction with its housing operates in a manner similar to the familiar "squirrel cage" ventilating fans. A forced current of air is established which draws cool air through the ports in the film gate and between the film gate and shutter housing in such a manner as to draw cool air *over and away* from the film, and over the aperture and its adjacent metal parts—a manner which efficiently cools this portion of the mechanism.

Its efficiency is at once apparent on comparing the temperatures obtained after a test in which a mechanism with the old type front shutter was subjected to the heat of the light beam for a period of thirty minutes. At the conclusion of the test the heat adjacent to the aperture registered 270 degrees. The same test repeated with a Model "H" mechanism with horizontal shutter in operation registered a temperature of only 100 degrees—only slightly more than room temperature. In addition to the cooling effect, this method of air circulation tends to draw away from the film any dust or dirt in suspension in the air.

Increased Screen Illumination

The third purpose, to provide an increase in screen illumination, is achieved also through the unique design made possible through the horizontal cylindrical formation of the rotating shutter.

Rotating on a horizontal axis it is possible to arrange two vanes of circular formation so arranged that one intercepts the light beam from top toward the center while the other vane simultaneously intercepts the light beam from the bottom toward the center. This action is clearly illustrated in Fig. 3. Reference to the illustration will also clearly show why this is a much more efficient cut-off than that of the front or disc type shutter which in action cuts off only in one direction either diagonally or nearly so across the long dimension of the picture or aperture. This is illustrated in Fig. 4. In effect, the horizontal cylindrical shutter provides a double cut-off across the narrow dimension of the aperture, a gain in efficiency over the disc type which has only a single cut-off.

In addition to the efficiency already gained by reason of the double cut-off, the horizontal cylindrical shutter made possible a more efficient design of shutter blade proportions. In most old type rotating disc shutters of the two blade construction, the area represented by the shutter blades is approximately 60 per cent and the light openings 40 per cent. In other words the shutter cuts off about 60 per cent of the light, allowing 40 per cent to reach the screen.

In the horizontal cylindrical shutter the blade dimensions are such as to provide 45 per cent blade area with 55 per cent light opening. Therefore, allowing only 45 per cent of cut-off and passing 55 per cent of the light to the screen—a gain of 15 per cent in screen illumination. This is clearly illustrated in Fig. 5.

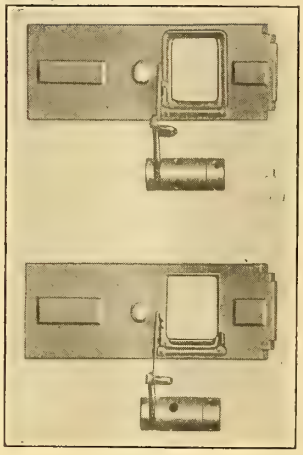


Figure 6

The action of the shutter resulting in a quicker cut-off of the light beam together with the two blades, one cutting off near the film and the other at a point further from the focal plane, provides a blending or diffusing effect during the cut-off and flicker interception. A highly desirable quality which insures a smoothness of operation resulting in flickerless projection at normal projection speed.

The horizontal cylindrical shutter housing functions also as an eye shield, an observation glass of special color providing clear view of the light spot without eye strain is conveniently positioned in the top of the housing. An interesting innovation is the built-in dowser, built in as a part of the housing and operating directly in back of the shutter. Its position is such that it cuts off the light beam before it reaches the shutter blades.

Provision is made for manually setting the shutter in a very simple manner. Only one screw is loosened, the shutter turned so that the edge of the top vane is in line with the darts plainly visible in the center at each side of the rectangular opening shown in Fig. 1. The intermittent movement at the position just ready to start the film in motion. Tightening the screw completes the operation. Setting the shutter to fine limits when the mechanism is in operation is equally simple. The small lever shown at the left of the shutter drive shaft bearing in Fig. 1 is loosened when the shutter may be adjusted as desired by the adjusting knob conveniently located at the right below the dowser handle as seen also in Fig. 1.

Aside from the horizontal cylindrical shutter feature, the Model "H" mechanism provides many other refinements and improvements. The built-in threading and framing lamp has always been an original feature with Motiograph DeLuxe mechanisms.

When equipped for sound, the mechanism may be provided with either of the aperture plates and sound film masks as illustrated in Fig. 6. One of these providing the standard aperture with mask covering the sound track only. The other having the standard aperture and mask for showing sound film to proportionate picture size. Either of the masks are readily interchangeable with each other or with the regular silent film masks. A simple lever operates the mask portion swinging it in or out of position in an instant.

Also when used for sound projection the mechanism may be provided with a special lens mount so designed for rapid exchange of lenses when it is desired to project sound film pictures to the same screen size as silent pictures. Included with the lens mount are lens holders which are attached directly to the lenses used. Focus and screen registration being pre-set with adjustment provided in the lens holders. Sideways displacement of the screen image is automatically taken care of by merely exchanging the lenses. Thus, mistakes are avoided through neglect to move shifting levers or other adjustments. The lens holders will accommodate any of the standard lenses now available.

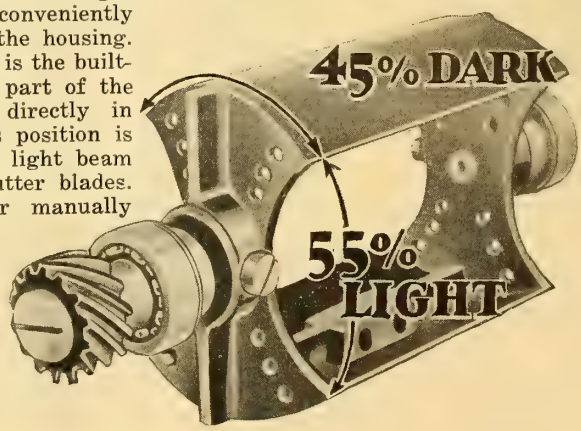


Figure 5

Types of Couplings Used for Sound Picture Amplifiers

By J. GEORGE UZMANN

WITH the advent of sound pictures the projectionist was called upon to operate a relatively complex piece of radio or signal communication apparatus in addition to his projection equipment. It soon became apparent that in order to be considered a good operator of this type of apparatus, it meant obtaining a complete knowledge of the operation of the various sound components. It is the object of this paper not to again describe the essential units of modern equipment, but rather to go into the non-technical details of the several types of audio frequency amplifier coupling systems. This is important because it must be remembered that a vacuum tube is generally considered to be the heart of the system, and, of course, the method of coupling one tube or stage to another proves it to be equally essential that a full appreciation of the problem be realized by the progressive projectionist.

Three Types of Coupling

It will generally be found that in sound picture work three essential types of amplifier coupling mediums are employed singularly or in combination in the several group amplifiers. By the coupling medium is meant (1) a transformer or other impedance, such as (2) an iron-cored choke coil or (3) a resistance. Each of these three units make up an impedance, which in turn must be of a value sufficient to form a "tube load" or "impedance ratio" so that the signal is efficiently amplified and transferred into a following amplifier tube.

It is all quite true that almost any form of coupling medium, regardless of its nicety of design, will invariably transfer signal or sound energy from tube to tube. However, in sound picture work we are interested not only in obtaining a maximum energy or sound transfer between tube stages, but what is most important is that the sound quality or fidelity of reproduction remains very nearly unaltered throughout the system. The latter characteristic is therefore a major consideration and this, of course, means that fidelity of reproduction, regardless of low operating efficiency, must first be satisfied, and a loss in volume, such as is the case with a resistance type of coupling can readily be compensated for by an additional stage of amplification.

As briefly mentioned before, three types of coupling mediums are ordinarily employed in sound projection amplifier systems:

(1) Resistance—Capacity.
(2) Choke coil—Capacity.
(3) Transformer.

Resistance and Choke Coil Couplings

In order to cite a practical case, let us glance at the circuit wiring diagram, Fig. 1, which shows a schematic view of a standard Western Electric type 41-A amplifier. Between the second and third 239-A vacuum tubes there will be noted a network made up of a resistor going into the plate circuit of the second tube.

The value of such a plate or load resistance is ordinarily from three to five times the internal tube plate resistance. Of course, the ratio could be smaller, but modern amplifier theory shows that for ratios smaller than three to five, the amplification per stage falls to a low value. Again, depending upon the type of tubes employed, low valued plate resistors result in a loss of tone quality.

In so-called choke coil type couplings an iron-cored choke coil replaces the plate resistor. There is little to choose from between the two methods of coupling, excepting the direct current resistance of the copper coil winding is, of course, much lower than is the case for a pure resistance, and therefore one does not experience a large "voltage drop" or loss. However, this characteristic is no longer important because modern rectifiers produce sufficiently high voltages to more than offset the loss.

On the other hand, a somewhat higher degree of amplification can be obtained from a choke coupling than from a resistance type, but a drawback is found in that unless such a choke is very carefully designed, the quality of reproduction may suffer. In other words, the reactance and resulting impedance of any type of copper coil winding goes through large changes due to tonal frequency.

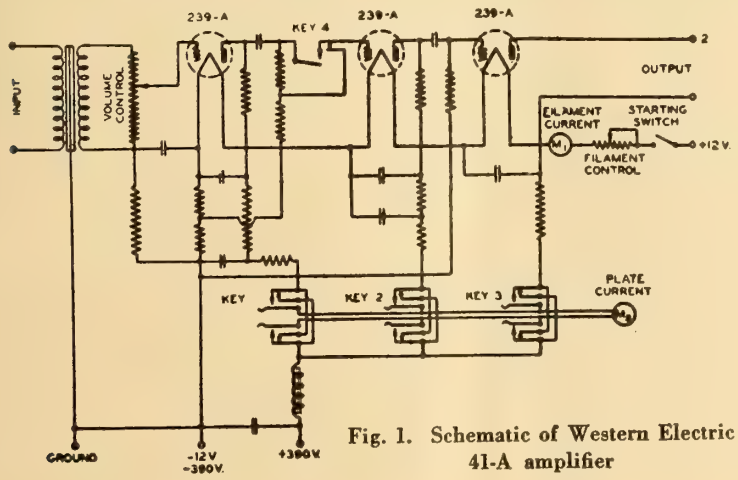


Fig. 1. Schematic of Western Electric 41-A amplifier

Resistance Type Preferable

For such reasons we find that the Western Electric type 41-A amplifier judiciously resorts to a resistance type of coupling within the several stages, particularly at the low volume end of the system where it is most important to maintain the highest degree of tone quality, because any inaccuracy at this point must, of course, result in added amplification and, finally, distortion being transferred from the loudspeaker system.

But to go back to the coupling, it is evident that before the signal reaches a succeeding tube it is forced to pass through a "blocking or coupling condenser." The latter serves a dual purpose: (1) to keep the high direct "B" or plate voltage off the grid of the following tube, and (2) the condenser must be of such order as to freely pass all audio frequencies or tones within the useful range of the amplifier.

Finally, a high value "grid leak" resistor is seen to connect between the grid of the third tube of Fig. 1 and the 12 V. "C" or grid biasing voltage. Tone fidelity depends largely upon the electrical values of (1) the coupling condensers and (2) the grid leak.

Transformer Coupling

This type of coupling in many ways possesses electrical characteristics not found in either resistance or choke coil varieties. For example, transformers result in better operation where the overall power or amplification becomes large, but due to their construction, the turn ratio existing between the primary and secondary windings can be so developed as to produce finally a voltage or power step-up or down. In fact, the transformer proves a most flexible medium or tool in the hands of signal engineers.

In other words, if we are dealing with an intermediate amplifier stage

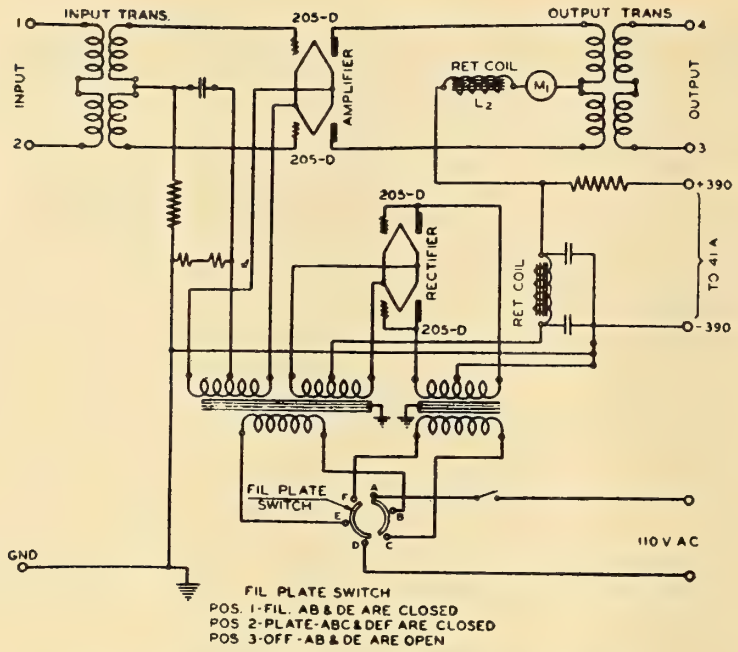


Fig. 2. Schematic of Western Electric 42-A ampliler

tube, theory shows these devices to be voltage operated and therefore the larger the signal voltage impressed on the tube grid, then the larger will be the change in plate current. For such reason, in the case of both resistance and choke coil couplings, one can never get a voltage amplification ratio larger than 1 to 1 (in practice it is generally much less than unity); nevertheless, high quality transformers are capable in themselves of impressing signal ratios from 3 or 4 to 1 upon the grid of a succeeding tube. This is a most important characteristic of transformers, but, of course, it requires a complete understanding of the problem so that tonal quality is not unduly sacrificed when gaining amplification.

Audio transformers can also be built so that instead of producing a maximum voltage output, as just shown, maximum current or power becomes equally attainable. This is a requirement for the case of the output transformers used for feeding our loudspeakers. Loudspeakers are power operated devices and simply one form of reciprocating motor mechanism. In this case we have a complete reversal in transformer characteristics over where such a unit is employed as a coupling medium within the intermediate amplifier system.

Push-Pull Amplification

Now let us glance at Fig. 2, which shows the schematic circuits of a standard Western Electric type 42-A power amplifier. Here we note, apart from the plate and filament supply system, that the amplifier consists essentially of a so-called push-pull system, whose output power is fed through a step-down transformer of proper impedance ratio so as to finally supply maximum undistorted sound energy to a series of loudspeakers. Incidentally, type 43-A amplifiers, which are used only for large theatre work, embody essentially the same circuit arrangements, except that 50-watt power tubes replace the 5-watt types found in 42-A amplifiers.

Looking at Fig. 1 we see how a step-up type of transformer employing a single secondary winding is connected up between the faders and the amplifier input. Now, in Fig. 2 the input transformer of the 42-A amplifier is of a different type, since the secondary winding employs a mid-tap connection for push-pull stage operation.

The technical phrase "push-pull" apparently is a sort of a stumbling block for many projectionists, and a few words describing the operation of this type of amplifier will not be amiss.

Analysis and theory of such a tube stage circuit shows that if we evenly divide an impedance—say, the transformer secondary—then the induced voltage within the winding will uniformly divide itself into two parts: thus if 40 volts are generated across the outside windings, then 20 volts will be impressed upon each tube. Now, since each tube is in a different or separate electrical circuit, the voltage on one branch will be increasing at a given instant while at the same time it will be decreasing in the opposite branch. Much the same order is followed with reference to the output circuits of the two tubes and it is from this basic principle that the phrase "push-pull" was coined.

Push-Pull Operation

Now, the effect of this mode of operation is severalfold. For example, if the maximum signal which can be placed on the grid of a given type of tube is, say, 25 volts, it is quite evident that a 40-volt signal would cause maximum distortion. However, through push-pull operation this problem is easily solved. Again, the power output of such a circuit is approximately double that of a single tube; and where still further power may be required, as is frequently the case, then two such amplifier systems such as the 42-A models can be connected in parallel.

A further important characteristic of the push-pull scheme is found in the fact that where so-called "phase distortion" exists due to the use of several inductances placed in tube plate circuits, a peculiar phenomenon results in that the signal wave shape becomes distorted. Such distortion develops harmonics, which are tones not found in the original signals. However, a push-pull stage in itself will not develop such a type of distortion and this again shows the wisdom of modern practice.

It is hoped that in this non-technical paper a number of essential features have been explained concerning the theory and operation of modern forms of audio frequency coupling devices found in the majority of present-day sound picture equipment, and that the projectionist will have a better understanding of that part of his operating equipment.

Courses in Illumination Offered by Westinghouse

Approximately 6,000 students have been enrolled and are now taking the correspondence course in General Illumination being conducted by the Westinghouse Lighting Institute, Grand Central Palace, New York City, which has been made available, without cost, to those interested in lighting.

Representing what is probably the largest attempt ever made for mass education in one subject by an industrial concern, the course, covering every phase of illuminating engineering, has been established to qualify all those in the fundamentals of good lighting practice and the modern developments of the art.

The course contemplates the collection of essential information from many sources, condensing and presenting it in logical sequence. It permits an absorption of illuminating engineering that would otherwise require the study of limitless volumes, often beyond the convenience of most lay students. The course consists of nine assignments, each covering a specific phase of illumination. These divisions embrace:

1. Light Sources.
2. Units of Light Measurement and Photometry.
3. Principles of Light Control and Equipment.
4. Interior Lighting Calculations.
5. Commercial Lighting.
6. Display Lighting.
7. Industrial Lighting.
8. Floodlighting.
9. Street Lighting.

Barrows Heads Projection Advisory Council

THAD BARROWS, President of Local Union 182 of Boston, Mass., was elected President of Projection Advisory Council at the annual meeting of the organization held in Town Hall, New York City, on March 24th last. Mr. Barrows, long active in all movements to better projection, was declared unanimously elected when the support of opposing candidates dwindled away to nothing just prior to the casting of ballots. Mr. Barrows succeeds Lester B. Isaac, first President of the Council, who was forced to resign his office due to pressure of Loew Theatres' business for whom he is Supervisor of Projection.

Other officers elected were Sidney Burton, Metropolitan Studios, 1st Vice-President; Lawrence J. Katz, Harrisburg, Pa., 2nd Vice-President; Harry Rubin, New York, Treasurer; and Laurence Jones, New York, Secretary. On the Board of Directors are Jesse J. Hopkins, New York, chairman; Joseph Clayton, Lester W. Bowen, Edward Keller, Charles F. Eichhorn, Victor Armand, W. C. Ricks, William S. Roberts, Otto Kafka, Rudolph Miehling, P. A. McGuire and Lester B. Isaac.

Membership Drive

Following the election of officers, the March 24th meeting was given over to a discussion of ways and means of expanding the scope of the Council. A concerted drive for new membership is already under way under the direction of regional vice-presidents, who, together with heads of committees, are listed elsewhere in this section.

Plans for an increased membership are now being laid under the direction of President Barrows, who will take an active part in assisting the regional vice-presidents. The active cooperation of every Local Union in the work of the Council will be solicited to the end that every Local Union may be represented in the Council by at least two men, if 100 per cent membership of all men on the roster is not possible. Manufacturers in the industry will be asked to help the Council by becoming members and cooperating by means of supplying technical data for papers which are to be prepared under Council auspices.

President Barrows has announced that he has already secured the active cooperation of a score of manufacturers who have proffered every possible bit of help. It is planned to name a man to establish and maintain contact with equipment manufacturers.

Preliminary reports and the formulation of definite plans for future activities will be the business of the next Council meeting which will be held in New York City on April 26th with President Barrows and other officers in attendance.

Committee Chairmen

Committee heads named by President Barrows recently are as follows:
Ways and Means—James J. Finn, New York.
Safety—George C. Edwards, New York.
Projection Room Planning — M. D. O'Brien, New York.
Sound—R. H. McCulloch, Los Angeles.
Effects—Harry Rubin, New York.
Law—Hirsch E. Stein, New York.
Awards—Thomas A. Reed, Washington.
Resolutions — Benjamin Stern, New York.
Public Relations — Harry Sherman, New York.



Thad. C. Barrows

Finance—Otto Kafka, New York.
History—Will C. Smith, New York.
Publications—P. A. McGuire, New York.
Theatre Managers—Charles E. Lewis, New York.
Publicity—James R. Cameron, Brooklyn.

At the first annual meeting of the Council the following regional vice-presidents were elected:

Charles F. Eichhorn, vice-president Local 306, New York, New York; Roger McKelvey, business agent Local 171, Pittsburgh, Middle Atlantic States; Theodore H. Eckerson, business agent Local 150, Los Angeles, California; Arthur Gray, Lancaster Theatre, Boston, New England; Frank Sutton, Loew's, Norfolk, Va., the South; Victor A. Welman, secretary Local 160, Cleveland, the Middle West; Chauncey L. Greene, Hennepin Theatre, Minneapolis, the Northwest; C. A. Dentelbeck, president Local 170, Toronto, and Canadian supervisor of projection for Paramount, Canada.

In a statement issued recently by Council officers, the work of the organization during the past year and its aims during the coming year were set forth as follows:

Appeal by Officers

We have accepted office in the Projection Advisory Council with the confidence that it deserves the support of all projectionists and the entire motion picture industry. We have closely followed its activities since it was formed and are aware that it has a splendid record of accomplishment. In spite of the fact that the Council is barely a year old and that it has been severely handicapped in many ways, it has achieved a splendid international reputation. There must be some good reasons for this.

The Council set out to do certain things, which seemed to need attention and has by no means succeeded in doing all it planned to do and would like to do. We have however, carefully investigated the work done, have ample evidence that a fine start has been made, that the work should go on vigorously and we are determined to do our part to build up the organization.

"Projection A Specialized Art" created a new viewpoint regarding the work of the projectionist. The contention of this paper was that the projectionist must be more than a technician and must have an artistic side developed through a practical knowledge of the show business, in order to properly do his work.

Distribute 70,000 Reports

The report of the Projection Room Planning Committee also attracted much attention and through its publication in various magazines, over 70,000 copies have been printed and distributed. Other articles have appeared in the trade magazines, which call attention to the importance of the work of the projectionist and create a better understanding between the management and projection departments. The Safety Committee has a big job and results come slowly, but the work is going on and eventually a valuable report will be submitted by this committee.

We have ample, tangible and practical evidence of the results secured through the work of the Projection Advisory Council. We have the written approval of some of the best-known men in the industry and the official endorsement of a number of important locals. We can give our own time to this work, but we must depend upon our members and friends to give financial aid. Every man connected with the active management of the Projection Advisory Council has his own work to do that keeps him busy. The introduction of

sound has made heavy work for all of us, but we are willing to make some sacrifice if we can get a little help from others.

We ask you to demonstrate your confidence by giving to us the only assistance most of the members can give. We are your representatives, and through you work and responsibility is delegated to carry on the organization. We promise you to seriously take up our duties and responsibilities and trust that you will give us your support.

We ask you to study the plans and purposes of the Council and we want you to make suggestions. With your assistance and confidence something worth while will be achieved. (Signed): Thad. C. Barrows, President; Jesse J. Hopkins, Chairman, Board of Directors; Harry Rubin, Treasurer; Otto Kafka, Chairman, Finance Committee; Laurence Jones, Secretary.

Barrow's Long Experience

Thad. C. Barrows, the newly elected President of the Projection Advisory Council, began his career in the motion picture field with the Howard Moving Picture Company of Boston in 1906. He received his license to operate a motion picture machine in Massachusetts in 1907 and in 1910 helped to organize and secure charter from the I. A. T. S. E. for Boston Local 182. He has held practically every office in Local 182, including financial and corresponding secretary, member of the executive board and treasurer. For the past fourteen years he has been elected President of Local 182, without opposition. From 1914 to 1930 he worked as chief projectionist of the Park Theatre, Boston, and when Publix opened the Metropolitan in Boston, the first Publix New England deluxe theatre, he was made Supervisor of Projection and now holds that position.

Thad. C. Barrows has attended many conventions of the I. A. and will be present at the coming convention in Los Angeles. He is a member of the Society of Motion Picture Engineers and American Projection Society and takes a keen interest in all activities for the betterment of his own craft and the motion picture industry.

It is worth noting that although Barrows has been so closely associated with the development and management of the Boston Local, he has always retained the confidence and strong friendship of the managers of theatres with which he has been connected. It is this ability to understand the problem of all branches of the industry which makes him particularly fitted to be President of the Projection Advisory Council.

Auditorium Acoustics

By Dr. Vern O. Knudsen†

Associate Professor of Physics, University of California

THE securing of satisfactory acoustics in an enclosed space is a straightforward engineering problem. If it is worked out in accordance with the known facts of architectural acoustics, the outcome is determinable and can be made to meet the most exacting requirements. There is no warrant for the superstition, or belief, still held by many that the acoustical qualities of an interior cannot be known until the structure is completed. It is true that difficulties may arise during the design or construction of a building, because of the limitations imposed by good acoustical design, but there are devices and materials the proper use of which will overcome the difficulties and secure entirely satisfactory results.

General Considerations

We shall first consider the limited problem of the hearing of speech in auditoriums. This is not only one of the most important aspects of architectural acoustics, but it is a problem which I wish to discuss in some detail because it will illustrate the value of scientific research in solving a specific problem in acoustical design.

Perhaps the most important single factor which affects the acoustic qualities of an enclosed space is reverberation. When sound is generated in an enclosure it is reflected back and forth by the boundaries until the sound energy is all converted into heat. The persistence of sound in a room after the source of the sound has been stopped is called reverberation. The time of reverberation is a measure of the time required for a sound to die away to one-millionth of its initial intensity; that is, the time required for the sound to be reduced in loudness to 60 db.

Calculating Reverberation

Ordinarily the time of reverberation is referred to a tone of 512 d. v., although it is necessary to know the time of reverberation for tones of all pitch used in speech and music, namely from about 50 d. v. to 5000 d. v. If the time of reverberation in an enclosed space is long, say several seconds, the successive sounds of speech or music remain audible so long that they overlap and confuse. The method of calculating and controlling the reverberation in rooms has been largely worked out by W. C. Sabine.

Ever since the monumental work of W. C. Sabine on reverberation there has been a growing tendency, especially in America, to rate the acoustic quality of an auditorium almost solely in terms of its time of reverberation. It is true that reverberation (which determines the rate of growth and decay of sound in a room) has been, and yet is, the most important factor in determining the acoustic properties of a room. However, reverberation is not the only factor affecting the acoustic properties of an enclosure. Thus, the size and shape of the room, and the presence of extraneous noise, all contribute to the resulting acoustic merit of a room.

It is not a simple matter to give a quantitative rating to a room which is to be used for music, since so much depends upon the musical taste and disposition of the listeners. It is, however, a relatively simple matter to give a quantitative rating to a room which is to be used for speaking, since our primary concern is how well we hear the spoken words of the speaker. The most feasible scheme for such a rating is probably the one used by telephone engineers for testing speech-transmission over telephone equipment, which goes by the name of "articulation tests."

The "percentage articulation" in any room signifies what percentage of typical speech-sounds can be heard correctly by an average listener in that room. A speaker calls out typical monosyllablic speech-sounds, in groups of three, at the rate of two syllables in two seconds.

Observers stationed in representative positions in the room write down what they think they hear. If, on the average, they hear correctly four-fifths of the total number of called speech-sounds, the articulation for this room is rated at eighty per cent. It would seem that such a scheme as this offers a satisfactory means for rating the acoustic quality of a room which is to be used primarily for speaking.

It is obvious that the percentage articulation in an auditorium will depend upon (1) the size of the room, (2) the reverberation characteristics of the room, (3) the amount of disturbing noise in the room, and (4) the shape of the room. It is apparent that, for speaking purposes only, the ideal auditorium is a small room free from all noise, and bounded by perfectly absorbing surfaces. In such a room the listener will be near the speaker and therefore the speaker's voice will be heard with adequate loudness. Further, there will be no interfering noise, reverberation or delay reflections.

Perfect Articulation Impossible

Actual tests conducted in a quiet open place have indicated that with average speakers and listeners the articulation in such a room will be about ninety-six per cent. This figure represents the highest attainable acoustic quality for speech reception

† Abstracts from a paper included in the Technical Digest of the Academy of M. P. Arts & Sciences.

Wide Film Optical Problems

By WILBUR R. RAYTON

Scientific Bureau, Bausch & Lomb Optical Co.

IN view of the present activity in the wide film field it is interesting to hark back and note the discussion of wide film optical problems by Mr. Wilbur R. Rayton in a paper which he read before the fall meeting of the S. M. P. E. last year. Mr. Rayton cites some of the optical problems which were overcome in the development of an optical system for wide film. His remarks follow:

The employment of film wider than the standard 35 mm. seems imminent in the immediate future. No one can say whether we will have to deal with one size or several but, however that question may be settled the difficulties encountered in designing adequate optical systems are of the same kind in all cases but differ in degree with the variations in width of film and size of projected image.

Sound Hurried Development

One of the reasons that is impelling the industry to adopt a wider film is the loss of area on the film formerly available for pictures, which is now given over to sound track. The addition of speech and music is also leading to a demand for a larger picture on the screen commensurate with the necessary volume of sound. The present screen is not only too small but the action lacks scope due to the necessity of crowding the action into a small space in order to obtain figures of sufficient size.

To meet the situation it is necessary to project a picture in which the figures remain of a sufficiently large size but which include more of them. This means, obviously, a wider included angular field of view and a larger projected picture.

To accomplish this two methods of attack occur at once. One is to alter the aperture now in use by reducing the height and to magnify the image in projection to the necessary size by the use of projection lenses of shorter focal lengths. The other method is to increase the size of the picture on the screen by increasing the area of the picture on the film thus making it unnecessary to increase the magnification in projection.

Illumination Data

. . . After the pictures have been taken the problem of illumination in projection has to be met. It is obvious that if the same amount of light which passes through the aperture of the film gate in an ordinary projector be spread over a screen area twice as large the illumination of the screen image will be only half as great. One obvious means of increasing the illumination is to increase the diameter of the condensers to obtain a greater angle of convergence. We found it possible to obtain a marked increase in angle with condensers of 6-inch diameter with aspheric surfaces, of course. A substantial increase in illumination resulted.

Some additional illumination, however, is possible by using an astigmatic condenser, one whose focal length in one meridian is shorter than its focal length in the other principal meridian. A preliminary investigation subject to possible correction indicates a gain of something like 25 per cent obtainable in this manner.

If, now, the arc be run at something like 150 amperes with condensers as described above, a satisfactory illumination will be found possible. It still remains a question as to just what degree of illumination will be required. It is possible that the relatively enormous picture on the screen may prove more satisfactory at a level of brightness lower than we have been accustomed to in the smaller picture. Certainly, a projected picture of, say 23 x 46 feet illuminated as brightly as some of the news reels we see might be expected to raise the general illumination of the theater to an undesirable level.

New Lenses

For the projection of the pictures ordinary projection lenses are entirely out of the question except in the longest focal lengths because of objectionable curvatures of field. It happened that I had been working on an improved form of lens for the shorter focal lengths for the projection of ordinary film when the demand came for lenses to project the large pictures. The design had progressed to the point where it was possible to offer lenses of 4-inch equivalent focal length and of a speed of F/2.2 which projected a picture 23 x 46 mm. with complete satisfaction. Since then it has been found entirely possible with lenses of 3-inch focal length. These lenses are, of course, anastigmats.

Auditorium Acoustics

(*Continued from preceding page*)

in a room. A rating of one hundred per cent, that is perfect articulation, can never be attained. A few of the consonantal sounds are sometimes mistaken even under ideal hearing conditions. We are ordinarily unaware of this when we listen to speech because the connotation of the articulated words facilitates the correct interpretations of those words which are not heard distinctly.

Even when the speech articulation is as low as seventy-five per cent the hearing will be regarded as acceptable. An articulation of ninety-six per cent is, for all practical purposes, about perfect, and therefore there seems to be no necessity for attempting to improve this limited ideal, although it could be done by altering slightly the pronunciation, or even emphasis, of some of the soft consonantal sounds.

An Australian Friend

We present herewith a likeness of Mr. S. L. Robinson, who is the representative of MOTION PICTURE PROJECTIONIST in Australia. While the land of the kangaroo may be far removed from these grand and glorious United States, we are informed by Mr. Robinson that projection technique compares favorably with the best produced in America. Most of the projection equipment in Australia is of American manufacture, and Mr. Robinson states that exhibitors in the Antipodes are as alive to the fact that "Better projection pays" as are their American colleagues. We hope shortly to present in these columns several pictures of Australian theatre projection rooms which will prove interesting as a comparison between equipments there and here.



S. L. Robinson

Mr. Robinson is at the service of Australian projectionists and all those interested in projection at 35 Prince Edward Ave., McKinnon, S. E. 14, Melbourne, Australia.

Canadian Bill Provides For Examination and Grading

ALL projectionists in the Dominion of Canada will have to appear before a government board shortly after June 1st next for an examination as to their fitness to work as a motion picture projectionist, under the terms of a bill which was introduced and passed recently in the House. The introduction of the bill was a complete surprise to Canadian projectionists, as there had been no untoward incident which might have prompted its introduction.

Oppose Administrative Features

As first drafted this bill was particularly obnoxious to Canadian projectionists for the reason that the second section provided that any inspector should have full power to cancel, suspended or revoke any projectionist license "at his discretion." This particular section, with its implied arbitrary power, drew the fire of all Local Unions, and so strong was the opposition marshalled by them against this provision that it was replaced by another which vests similar powers in an appeal board which will be comprised of an in-

spector, a projectionist, and an exhibitor.

Projectionist opposition was centered on the administrative features of the bill. Section 2 granted to any inspector the power of picking up a man's ticket for one, two or three weeks, at his discretion, which process would mean the loss of about $200 to men in the larger cities. Smoking and reading in the projection room are recognized by all Local Unions as serious infractions of the rules, and local penalties are provided. In case of a fire from any cause, however, the inspector was expected to pick up a man's license immediately. Under this procedure a man would be considered guilty as soon as the fire occurred, and there would be no appeal from the decision of the inspector who would be constituted as judge and jury.

Canadian projectionists express no great concern on the point of the forthcoming examinations, as they are confident of making a good showing. Gradings will be made on the basis of the mark attained in the examination.—H. N. ELLIOTT, Toronto, Canada.

Transformer Information

By A. C. SCHROEDER

A. P. S. No. 7

TRANSFORMERS are made in a great variety of types and sizes, and are used for many different purposes. There are only a few things that all transformers have in common, namely, at least one primary and one secondary winding, and a magnetic field linking the two or more windings.

In an auto-transformer the primary and secondary are part of the same winding. There are certain transformers that do not use copper for the windings, but use a resistance wire instead. These are used only for special purposes.

Windings are not always of round wire, but are very often made of flat copper strips. This conserves space and makes the transformer more compact. In the largest sizes, which are required to carry heavy currents, two or more strips are sometimes wound side by side, or one on top of the other. This, in effect, is nearly the same as two or more similar windings connected in parallel.

Winding Insulation

Insulation on the windings varies, being cotton, silk, enamel, and cotton tape. The cotton tape is used when the windings are flat strips. Silk and enamel are used only on the smaller transformers.

In large transformers steps have to be taken to keep the temperature down. In such cases the windings are so arranged that there are spaces left in which the cooling medium can circulate. The core also has spaces in it, which help to cool the entire transformer. Either air or oil is used for the cooling. On very high voltage circuits oil is used exclusively, as this also helps to insulate the windings, being much better in this respect than air is.

Types of Cores

Not all transformers have an iron core. Nearly all radio frequency transformers have only air in which the magnetic flux circulates. In other types the core varies from iron and steel, which is the most used, to permalloy, which is used in a few types of audio frequency transformers. Permalloy has only a limited use as a core material due to the fact that it saturates at very low flux densities. It is composed of about 85 per cent nickel and has extremely high permeability.

The cores of transformers are made in many different shapes. In nearly all cases it is continuous; that is, of such a shape that the magnetic flux has an unbroken path of iron to traverse. This reduces the magnetic reluctance, which can be compared to resistance when dealing with electric currents. It is for this same reason that the core is made as short as possible. The limiting factor being the fact that the length of the windings is greatly increased by making the cross section of the core unduly large, and when the length of the windings is greatly increased the I_2R losses (losses caused by the resistance of the windings), become greater than the saving which results from a large core. There is one point which slightly offsets this bad feature, that is a transformer with a large core does not require as many ampere turns as one with a smaller core, other things being equal.

"Citizenship" Bill Dies

The New York State Legislature adjourned recently without taking any action on a so-called "Citizenship" bill which, if passed, would require that every motion picture projectionist holding a license in New York State would have to be a citizen of the United States and 21 years of age.

This bill, along with several others which were aimed directly at the projectionist, died in committee.



General view of banquet hall at 3rd annual dinner dance of Local Union 650 of Westchester County, N. Y.

New Advances in the Art

New Sensitive Relay

A NEW sensitive relay for use in conjunction with photo electric cells has been perfected recently by the G-M Laboratories, Inc., of Chicago. Engineers have received this new relay very favorably as they find it meets a long-felt want in the conversion of photo electric reactions into electrical impulses, thus permitting the operation of auxiliary apparatus.

G-M Sensitive Relay is complete in itself, as it embodies a very efficient one-stage amplifier using standard UX-199 type tube, which makes possible sensitivity to as minute a change in light intensity as .005 of a lumen.

Many Applications

G-M Sensitive Relay can be put to a multiplicity of uses, in conjunction with photo electric cells, some of them being: the counting of moving objects; the grading of materials according to color; the inspection and testing of new and finished products; and smoke control, and it has many applications in the research laboratory. In short, this G-M sensitive relay, used with its "eye," the photo electric cell, can be made to perform many functions in industry now being trusted to human skill and judgment.

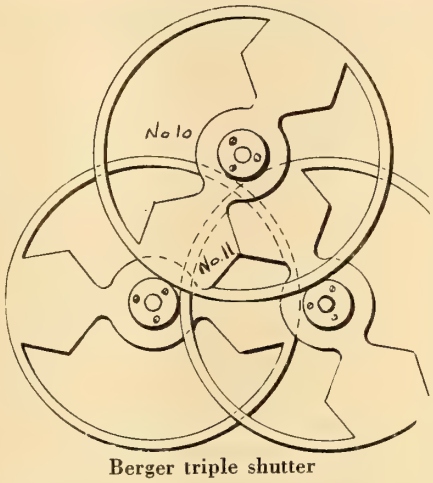


G-M Labs. amplifier

The G-M Laboratories, Inc., are the manufacturers of *Visitron* photo electric cells, which are a recognized standard in the sound motion picture industry, using sound-on-film. Anyone interested in their sensitive relay can be supplied with photo electric cells as well. Full details will be sent promptly on request to G-M Laboratories, 1803 Grace St., Chicago.

Berger Triple Shutter

One of the latest developments is a triple shutter for motion picture projectors which is being distributed by Globe Reliance Corp., Minneapolis. This shutter delivers from 25 to 50 per cent more light on the screen, according to its sponsors, and gives better depth and clarity to the picture. It is also claimed that this shutter practically eliminates flicker and consequent eye strain. Sound pictures demand more illumination which results in increased heat on the film, but this new shutter is said to accomplish a substantial heat reduction.



Berger triple shutter

The apparatus consists of three distinct shutters with two or three fans each, the fans having convex edges which meet, cover, and uncover with a very minimum loss of light; a three-sided aluminum housing in which is located the three sprockets, run together by a fine high grade chain—all of which are driven from the regular machine shaft.

The saving in light relieves the increase in voltage and consequent increased danger from heat, according to its makers, and the much brighter and more distinct picture eliminates flicker.

Perfect Projection

EXCELLENT projection work in connection with the recent presentation of Grandeur wide film at the Roxy Theatre in New York City prompted the following commendatory letter from Grandeur sponsors to S. L. Rothafel (Roxy). This letter, which is indicative of the good will which is being engendered these days by alert and progressive projection crews, follows:

Dear Mr. Rothafel:—

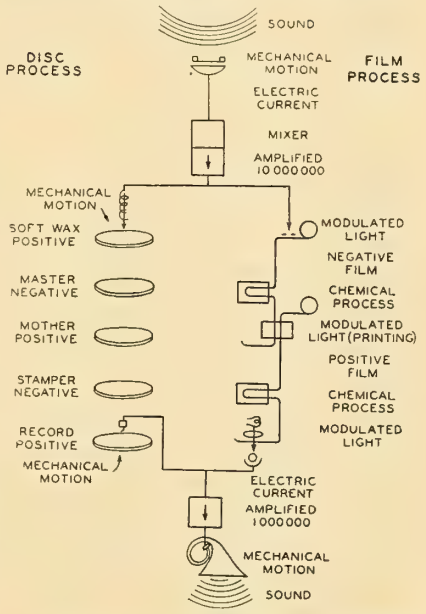
I am writing this letter in token of our appreciation for the hearty cooperation which we received from your projection room staff during the installation and showing of Grandeur.

Will you kindly extend our thanks to your projectionists for their whole-hearted support in helping us put this show over.

L. W. DAVEE, FOX CASE CORP.

Recording Processes

A remarkable feature of the recording sound on film system is the number of mutations (see accompanying illustration), through which the embodiment of the sound passes, to emerge at length with extraordinary fidelity. Thus, in the film system, sound imparts mechanical motion to the diaphragm of a condenser transmitter which translates the motion into a minute electric current. After amplification the current modulates a light, to which film is exposed. The resultant latent image is developed chemically and permitted to modulate a light to produce a positive print. The developed positive modulates a light in the projector, which controls a minute electric current through a photoelectric cell.



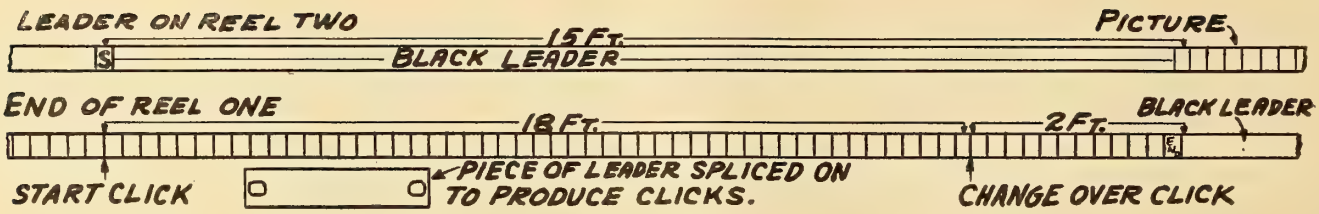
Transmutation of sound from recording stage to reproducing stage

After amplification the current imparts mechanical motion to a loudspeaker diaphragm, which sets the air into a vibration closely approximating the original sound.

A similar series of transformations takes place in the disc system, also shown in the illustration.

New Changeover Cue

MANY projectionists experience difficulty in calculating changeover cues, due to the length of blank leader on the front of each reel. In ten projection rooms which I visited, the projectionists in all but three rooms ran down all the black leader immediately after threading the projectors. Most projectionists disregard the black leader because they believe it is placed on the reels to allow the machine to get up to normal speed



Diagramamtic representation of new changeover cue operation

before changing over. There is, however, another and important reason why this black leader should be used in starting the projector for the changeover.

Very often there are spoken words immediately at the start of a picture. It naturally follows that if the machine is framed on the start of the picture, some of the words are run off before the change occurs, and therefore the perfect change is one in which the projector is thoroughly up to speed, and in which the first scene arrives at the aperture, just at the cue. In this way no action or sound is lost on either reel.

A method of creating changeover cues has come into use lately that is probably the simplest and most efficient system yet devised. It is superior to spoken cues or action cues because it works from the very first time, without any guesswork. It consists simply of attaching a piece of plain leader to the back of the film in the form of a splice. This piece of film is cut the width of one perforation, as shown in the illustration. The splice, in passing through the mechanism, produces an audible click. Two of these splices are attached at the end of each reel: the first click gives the signal to start the following reel, and the second click is the changeover cue.

Easily Attached

These splices can be attached easily by laying the film on a splicing machine and using the pins that pass through the sprocket holes to guide the small piece of film into place. In this way the sprocket holes of both films will register perfectly.

Any projectionist can use this system by determining the number of feet of film required to get the projectors up to normal speed. The old-type W. E. motors require a difference of about six feet. The late-type W. E. apparatus requires a difference of about three feet. In other words, five feet of film is passing through the machine that is running, while the other is getting up to speed, using two feet. This difference must be added between the two clicks.

To determine the place to put the clicks, first measure the amount of blank leader following the start mark of the next reel. For example: part two has fifteen feet of black film between the start mark and the beginning of the first scene. Now measure two feet from the end of part one. The changeover click is attached here. Next, measure fifteen feet of film, plus the pick-up difference. Attach another piece of film here for the starting click.

Always allow two feet after the changeover click. This gives you almost two seconds to make the change after hearing the cue. The entire process is shown in the illustration, considering a three foot pick-up difference. This difference will vary with different types of equipment, but once you have determined the number of feet lost in pick-up, you will have no trouble in making a perfect change with any reel.

P. E. Cell Fire Hazards

By A. J. McMASTER

G-M Labs., Inc.

I AM indeed glad to contribute my views on the very interesting question posed by one of your subscribers with regard to the possibility of the photo electric cell constituting a fire hazard. Photo electric cells of the type used in sound projection work should be stored in a cool, dry place. A steel storage cabinet or steel spare parts case in the projection room would be an ideal place for the safe keeping of cells.

Alkali metal photo electric cells must not be exposed to excessive heat, since high temperature causes rapid deterioration of cell sensitivity. Such cells offer no fire hazard unless the glass bulb is broken. However, the chemical contents of the cell oxidizes slowly upon exposure to air, which oxidization becomes very rapid in the presence of moisture or water. This rapid oxidization is accompanied by a generation of considerable heat which is sufficient under certain conditions to produce a sputtering flame or slight explosion.

Care in Handling

In the care of photo electric cells it is therefore advisable to avoid rough handling because of the possibility of breakage. If the cell should be broken it can be placed in a covered metal container where it will slowly oxidize by exposure to air. After a few days the remaining chemical compound is completely oxidized and has no further properties of ignition.

Incidentally, we are completing the development work on a new type of cell which completely eliminates any possibility of such a fire hazard. The new product will also incorporate much higher sensitivity, resulting in lower noise level and generally improved performance.

Book Review

PHOTO ELECTRIC CELLS—By Norman R. Campbell and Dorothy Ritchie. 209 pages. 6 x 9 inches. Stiff buckram binding. Published by Isaac Pitman & Sons, 2 West 45th St., New York. Price, $4.50.

One of the authors of this book, Mr. Campbell, is known to this reviewer as being a capable worker in the phenomenon of photo electricity, especially so in the matter of commercial adaptation of photo electric cells, thus any work of his on photo electricity may be regarded as authoritative. *Photo Electricity* was written as a "laboratory or workshop tool" for those who have occasion to need an instrument for measuring electrical and other physical phenomena.

The book is divided into three parts: (1) Theory of Photo Electric Cells, (2) Use of Photo Electric Cells, and (3) Applications of Photo Electric Cells. These three main divisions are further divided, of course, into chapters—16 in all.

In the opening chapter the authors define the term "photo electric" as "the emission of electrons under the influence of light," and distinguish this phenomenon from other forms of light sensitive cells—as, for example, selenium—in that the latter is "photo conductive" (in which the resistance of the material changes upon being subjected to light). The authors of *Photo Electricity* are to be congratulated for this distinction between two forms of light sensitive cells, since the need for so doing has already been made quite apparent in various papers presented in these columns.

Photo Electricity is quite technical, by which is meant that it will undoubtedly have a wider appeal to serious workers in the art rather than to those who have but a general interest in the subject. The subjects treated in this book are interestingly presented indeed and there is an abundance of authoritative facts which will command the attention of those who are familiar with the art. This book is recommended without reservation to all those who desire to increase their knowledge of the photo electric effect.—SAMUEL WEIN.

Everyday Science

Change of Body's Water Every Three Weeks

The water of the human body is changed on the average every three weeks, as though the living tissues were a reservoir kept fresh by a stream continually flowing in and out. Salt in the body is changed about every 22 days but other bodily materials are much more permanent. So concludes Dr. Edward F. Adolph, of the University of Rochester, in calculations reported in the *Quarterly Review of Biology*.

The familiar idea that every living cell in the body wears out and is replaced by a new one every seven years has no scientific support, for some cells like those of the brain are believed to last during life. Chemical elements of the body may be regarded, however, as being changed continually, new supplies entering day by day in food or drink while other quantities of the same elements are lost in bodily secretions. Next to water and salt, Dr. Adolph's tables show the element thus changed most rapidly in the average human body to be potassium, an element believed to act as a regulator of activities of many kinds of living cells. The average bodily turnover of potassium occurs in about 72 days. Magnesium, another element believed to act in regulating vital activities, is changed every 103 days. The body's supply of nitrogen, the fundamental element of muscles, is turned over in an average of 290 days; while iron, essential element of the blood, changes about every 300 days.

As might be expected, phosphorus and lime, essential elements in the body's most permanent structures, the bones, change less rapidly than the others; about 800 days, Dr. Adolph's tables indicate, for the phosphorus and over 2,300 days for the lime.

Photo-Electric Color Analyses

The accuracy of blood and other physiological analyses, which often depends upon the accuracy of color observation on the part of the analyst, has been enhanced by the development of an artificial eye which can be carefully calibrated in reference to sensitivity to different colors. George Lewis, Vice President of the Arcturus Radio Tube Company, Newark, N. J., describes the photo-electric apparatus under development in the laboratories of his company as an aid in such work.

Color Blindness

"The human eye," declares Mr. Lewis, "almost invariably suffers to an extent from color blindness. Some persons are more color blind than others, and most of us will find that one eye sees objects at a slightly different shade than the other. This can be noticed by looking at a highly colored picture first with one eye and then with the other. Color blindness, slight or even acute, has little effect upon our success in life, if we are lawyers, automobile mechanics and about seventy-five per cent of all possible trades and professions. But when it comes to blood and other physiological analyses, where color is often a determining factor, an electric eye, such as the photo-electric cell, which never suffers from color blindness, or even retinal fatigue (which may affect even the normal eye), is a considerable contribution to the accuracy of results.

"The photo-electric eye can detect color differences beyond the sensitivity of the best human eye, and can relay its decision to amplifying apparatus that will indicate the color or variation from a standard color on a printed form for a permanent and accurate record."

Check-Up on Mosquitoes

Part of the Winnipeg, Canada, district crop of mosquitoes will fly forth this year arrayed in multi-colored wings, and stingers, royal purple predominating.

Sounds like a fairy tale, but it is true, vouched for by Dr. H. M. Speechly, Chairman of the Winnipeg anti-mosquito campaign.

A number of mosquitoes will be placed behind a fine gauze screen and sprayed with a solution of aniline dye. They will be released at various points and afterward recaptured. The object of this is to determine the distance that Winnipeg mosquitoes will fly in a given time. This information will mean extermination of the germ-carrying pests.

Cement Finely Ground

Cement is ground to a fineness which enables 78 per cent to pass through a silk screen which will hold water.

Weather 'Stands on Head'

When hot nights come there is some comfort for persons compelled to occupy sleeping chambers near the ground. The airy room, high above the street, is likely to be cooler much of the time, but there are exceptions, when the coolness stands on its head.

The phenomenon called temperature "inversion," is described to the American Association for the Advancement of Science by R. A. Dyke of the New Orleans Weather Bureau.

This somersault of temperature occurs principally on clear nights when there is little wind, he finds. The height of these inversions is from a few hundred up to more than 1,000 feet.

This inversion also occurs in winter, and accounts sometimes for official weather bureau readings of above freezing, when the ground is covered with frozen puddles.

Sir William Crookes's Light Experiments

SIR WILLIAM CROOKES said of himself in 1904, "From my earliest recollections I was always trying experiments and reading any book of science I could find. . . . I fitted up a cupboard as a sort of laboratory, and caused much annoyance and trouble in the house by generating smells and destroying furniture. . . . I was always regarded (by his family) as a bit of a fool, who would never get on." But he did "get on"—though he would probably have said he "got off and on." His fortunes varied.

He entered the Royal College of Chemistry in 1848, and in 1851, at 19, he was senior assistant to its head. In 1855 he spent one year as teacher of chemistry at the Chester College of Science. Following his marriage in 1856, his income was variously derived from photography, editing, giving lectures on chemistry, and after money troubles galore, at 33 he set out to get wealthy by a new method of extracting gold and silver from ore.

He made disinfectants to fight plagues; fertilizers and deodorants, but always Crookes experimented fondly with light. He photographed rays that the eye had never seen before, he discovered a metal . . . thallium . . . from the unusual green lightline in its spectrum. He took pictures of solar eclipses, measured the corona of the sun and studied the power of repulsion in light rays, inventing the radiometer to measure the force of light radiations.

William Crookes was first to produce a vacuum containing only one-millionth the original amount of air. Without the mercury air pump, Crookes could not have done this thing, which was to lead to the incandescent bulb and modern lighting.

After perfecting the mercury air pump so he could get a high vacuum in a glass tube, he passed an electrical discharge into the tube. A golden-green glow was produced. By enclosing different gases in tubes, Crookes got different luminous effects, and very nearly discovered the X-ray.

Instead of electrifying a gas in a tube, Edison simply passed the current through a filament placed in a bulb "exhausted to a high vacuum,"

and he had a modified Crookes tube which we call the incandescent lamp.

Crookes soon made electric lamps, also; establishing lamp works at Battersea, in charge of his son. Though he left the industrial arena to Edison and others, the jury of the electrical exhibition at Paris officially stated: "None of them would have succeeded but for the extreme vacua which Mr. Crookes has taught us to manage."

Dial and Other Telephones

According to recently released statistics compiled up to December 31, 1929, 4,014,000 of the 15,414,000 telephones owned by the Bell System in the United States, approximately 26 per cent, are dial operated. The report also shows the associated companies comprising the Bell System operate a total of 6,396 central offices.

By virtue of the transoceanic radio and other long distance service, Bell System telephones can be connected with 29,500,000 of the world's 34,500,000 telephones.

Artificial Echoes Make Phonograph Sound Like Orchestra

An illusion of being in a great hall listening to an orchestra or of hearing a large band marching past in the open air can be obtained from ordinary phonograph records, it is claimed by the French radio expert, M. P. Hemardinquer, by the expedient of playing the record with two needles at once. The two needles cannot be inserted in a single needle holder. Instead, there are two holders and two reproducers, so arranged that the sounds produced by one are a trifle later than those from the other, the second needle following a fraction of an inch behind the first along the groove of the record. Modern electric phonographs make it relatively easy to attach this second reproducer.

Last year an American acoustic engineer, Mr. R. F. Norris, of the C. F. Burgess Laboratories, demonstrated before the New York Electrical Society a two-needle phonograph to simulate echoes in a hall or building. M. Hemardinquer uses a similar device but with the second needle so closely behind the first that no interval is perceived and no illusion of an actual echo is produced. A very close electric echo, differently produced but said to create a similar impression in listeners, is now being tested in London.

Two Billions on Earth

The population of the earth has gone over the 2,000,000,000 mark, according to estimates by the International Statistical Institute.

Asia has 950,000,000, Europe 460,000,000, North and South America 230,000,000, Africa 150,000,000 and Australia 7,000,000. Island regions bring the aggregate above 2,000,000,000.

Figures issued in May, 1927, on the basis of data prepared by the League of Nations, gave a total world population of 1,906,000,000.

'Electric Chair' for Insects

An "insect electric chair" has been invented at the Bartlett Tree Research laboratories. It is a new device for killing insects. Heretofore they have been sprayed, drowned, swatted and caught in traps.

The electrical device resembles a large ornamental lantern, of square, wide bottom. Two of its sides are made of fine wires, charged with electricity to kill insects lighting on them or attempting to crawl through.

Harmless to Humans

Though fatal to many insects, the current cannot be felt by a person placing his hand on the wires, and is not dangerous to human beings. It is an ordinary house lamp current, run through a transformer. The lantern is made to hang on trees, screen doors, or wherever insects congregate. It works twenty-four hours of the day. In daylight bait inside the lantern attracts the insects, and at night an electric light bulb lures them.

Reduces Heart Flutter

Palpitating hearts the world over need palpitate no longer if the claims of Dr. E. Zuelzer of Berlin are true. He announced to the Berlin Medical Society the discovery of a heart hormone which reduces palpitation to a minimum.

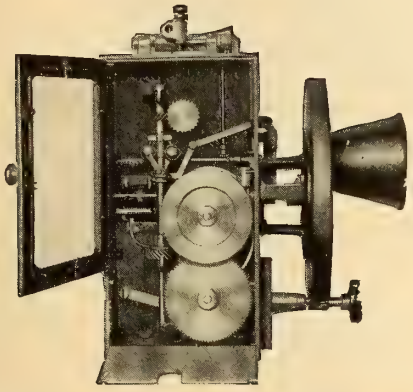
He calls it eutonon and says it is isolated from liver and muscle. It reduces the size of the heart, he claims, enabling it to function with less oxygen. It also enlarges the coronary vessels so that they put more oxygen into the blood.

He says that athletes who received it in training showed reduced fatigue and, above everything else, no signs of palpitation of the heart.

	WIRE			NO OF WIRES IN ONE CONDUIT								
SIZE	OHMS PER 1000 FT.	C.M.	AMP.	1	2	3	4	5	6	7	8	9
14	2.50	4107	15	1/2	1/2	1/2	3/4	3/4	1	1	1	1
12	1.62	6530	20	1/2	1/2	3/4	3/4	3/4	1	1	1	1 1/4
10	1.02	10380	25	1/2	3/4	3/4	1	1	1	1 1/4	1 1/4	1 1/4
8	.641	16510	35	1/2	3/4	1	1	1	1 1/4	1 1/4	1 1/4	1 1/4
6	.413	26250	50	1/2	1	1 1/4	1 1/4	1 1/2	1 1/2	2	2	2
5	.319	33100	55	3/4	1 1/4	1 1/4	1 1/4	1 1/2	2	2	2	2
4	.253	41740	70	3/4	1 1/4	1 1/4	1 1/2	2	2	2	2	2 1/2
3	.201	52630	80	3/4	1 1/4	1 1/4	1 1/2	2	2	2	2 1/2	2 1/2
2	.159	66370	90	3/4	1 1/4	1 1/2	1 1/2	2	2	2 1/2	2 1/2	2 1/2
1	.126	83690	100	3/4	1 1/2	1 1/2	2	2	2 1/2	2 1/2	3	3
0	.1	105500	125	1	1 1/2	2	2	2 1/2	2 1/2	3	3	3
00	.07	133100	150	1	2	2	2 1/2	2 1/2	3	3	3	3 1/2
000	.06	167800	175	1	2	2	2 1/2	3	3	3	3 1/2	3 1/2
		200000	200	1 1/4	2	2 1/2	2 1/2	3	3	3 1/2	3 1/2	4
0000	.05	211600	225	1 1/4	2	2 1/2	2 1/2	3	3	3 1/2	3 1/2	4

Standard table for rubber insulated wire

THE PROJECTOR
OF TODAY AND TOMORROW
is the
SUPERIOR



A leader in Improvements for the betterment of Projection.

Ask our dealers to show you our latest improvements.

Manufactured by
COXSACKIE HOLDING CORPORATION
COXSACKIE, N. Y., U. S. A.

VOLUME CONTROLS—A LA CARTE

Of course no one would think of eating volume controls. But there is nevertheless as much difference between ordinary, hand-me-down, stock volume controls and the CLAROSTAT volume controls fitted to your precise needs, as there is between a plain *table d'hote* and the *a la carte* feast.

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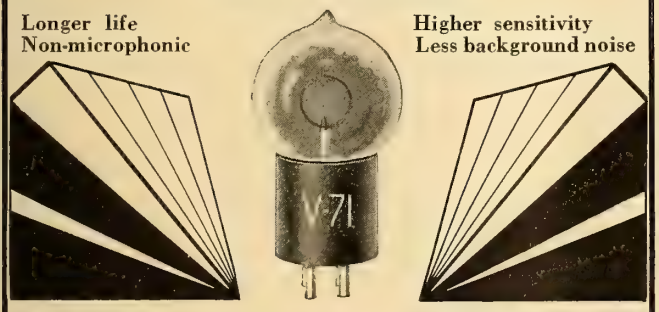
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Bell Labs. Show Television-Telephone

TELEVISION has climbed several more rungs in the ladder of progress in the Bell Telephone Laboratories. A television-telephone booth has made its appearance. Details of a successful demonstration of this amazing apparatus were presented recently in *The New York Times.* The man in the booth sees the person with whom he is talking at the other end of the line. This television system, which is established only over three miles in New York, considers distance no barrier as long as a wire or radio channel is available. But today radio transmission is more uncertain and full of more flaws than the telephone line in carrying the images. Radio vision is a hope for the future.

Now, suppose that a transcontinental wire or radio circuit is in use and a person in New York wishes to speak with a friend in San Francisco by television so they can see each other. They step into television-telephone booths which are about the same size as an ordinary phone booth. They turn in swivel chairs and face the screen, about a foot square.

The faces are rapidly scanned by a mild beam of blue light which reflects from their faces to the photo electric cells and gives rise to the current which transmits their image to the distant booth. There is no fierce glare to the scanning beam; and one is not annoyed by its presence and may even gaze directly at it without inconvenience.

Telephone Transmitter

The first thing that puzzles the observer when he steps into the booth, which is lighted with a dim orange light to which the photoelectric cells are insensitive, is the absence of the usual telephone. Special telephone transmitters and receivers are concealed in the booths. The speakers talk face to face and a hidden receiver speaks the words. An ordinary telephone is not used because it would hide part of the speaker's face from his distant observer. This novel arrangement of concealed transmitter and receiver avoids that difficulty and adds naturalness to the conversation. A microphone, as used in broadcasting, replaces, the telephone transmitter.

The other party to the television-telephone conversation appears with sufficient detail for recognition of facial expression, but the effect is rather like looking at an animated cabinet-size photograph. This is because the image is produced in monochrome. What one sees is like an instantaneous moving picture done in black on a pink background due to the color of the water-cooled neon tube, whose flashing light is viewed through the synchronized scanning disk which forms the image eighteen times a second.

Improved P. E. Cells

The photo electric cells, or "radio eyes," used in picking up the face which is to be transmitted, have been much improved in sensitiveness and give rise to about ten times the current for the same amount of light as did those developed for the 1929 demonstration. Increased sensitivity and the use of the blue scanning beam have made possible the reduction of the dazzle and glare which occurred to a certain extent in the earlier forms of apparatus.

The person whose image is being transmitted is therefore practically unconscious of the fact that his face is being swept eighteen times a second by a scanning beam of light. The beam is not bright enough to interfere with his seeing the image of the person to whom he is talking.

The speaker sees a blue spot of light and below that through an inclined plate of glass a small frame showing the words, "Ikonophone—Watch this space for television image." He is told that as soon as the party he is calling is similarly placed in the distant booth, this sign will be lifted and in its place he will see the other party and that when he does so he may start talking. Then the sign is drawn aside by the operator; and one finds himself looking at an animated picture of the person he has called. When this unique telephone conversation is completed and he swings his chair around to leave the booth the sign reappears ready for the next conversation.

Much Work Remains

"While the equipment now available for television is simpler and more efficient than that employed in the 1927 demonstrations and the results are very greatly improved, the terminal apparatus is still inherent-

(*Continued on page* 42)

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Projection "A. B. C.'s" for Newspapermen

FOLLOWING the first showing of "Rogue Song" at the Astor Theatre in New York City there was much criticism in both the public and trade press on the matter of poor sound reproduction, the projection crew at the Astor being scored as careless, incompetent, and lazy. Daily newspaper critics might well be excused for their attitude with regard to projection work on the ground that they are not assumed to, and probably do not, know very much about sound reproduction technique. As for the trade papers, there is no apparent excuse for their shortsightedness, but this is an old story.

Under the circumstances the temptation to write one or more scorching letters to the critics in question was very strong; but through the medium of the Projection Advisory Council the matter was handled in a much more satisfactory manner. The following article by the motion picture reviewer of *The New York Evening Post* is self-explanatory and is indicative of the fine work being done by the Council:

Those Superb Craftsmen

Through the courtesy of the Projection Advisory Council, an organization devoted to the interests of those mechanical wizards who operate the projectors in picture houses, I was recently given a brief but intensive course of instruction in the intricacies of the projection room.

To the layman there is something revealing in the complicated and highly responsible office which devolves on those who control the sound and visual machinery of reproduction. The impression is widespread that the faults and virtues of sound reproduction lie almost wholly with the actual taking of the picture, and that the operator in the theatre has only to press a few buttons and thereupon smoke a cigar while the film unreels itself.

Projection a Mystery

That this misconception should be so prevalent is only natural when you consider the enormous publicity which centers around the picture studios and the corresponding obscurity of those less glamorous souls whose duties are shrouded in technical mysteries. But let me assure you that the projection room, with its bewildering array of dials, indicators, gauges, and electrical what-nots, to say nothing of the formidable projection machines which point through little windows down into the auditorium below like a battery of light artillery, contains within itself an abundance of marvels, even to one whose knowledge of things scientific is considerably below zero.

After being shown around by Mr. Smith, of the projection room staff at the Astor Theatre, I came away with increased respect for this whole problem of sound in pictures.

For one thing, I learned that the smoothest sound effects can be ruined by carelessness or inexpertness in the projection room, and that it is only by constant vigilance and intelligent supervision that a picture is kept to its proper value. And conversely, I found that not every instance of defective sound is blamable on the projection room operators. The studios not infrequently turn out a film in which the inadequacies of sound are responsible for the flaws which the untutored layman is prone to ascribe to the operators.

The functions of the projection room are not confined to mere mechanics. The operators have to know their pictures thoroughly in order to get the cues for the changeover from one reel to another, and to signal the stage crew at the right moment for the drawing of the curtains. This necessitates a fair knowledge of music, since the cue at the end of a reel may occur in the musical score. Under ideal conditions a new picture is given a preliminary rehearsal before it goes on for the public, but oftentimes, and in the smaller houses especially, the films do not arrive until a half hour or so before the scheduled performance. In that case the operator gets the blame when things go wrong. All in all it's a ticklish profession, and one that fully justifies the pride which its practitioners take in it.

W. E. Small-House Equipment

Western Electric has announced that by July 1 it will be ready to distribute through its subsidiary, Electrical Research Products, a new small theatre sound picture system. Sound-on-film section of this new equipment will sell for approximately $3,500, with disc equipment to cost about $1,300 additional.

Installations on this new size equipment is expected to begin about the middle of July and continue rapidly throughout the summer and fall months.

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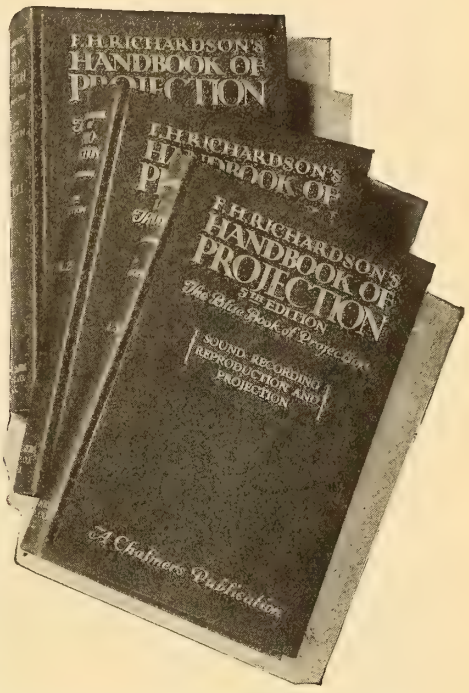
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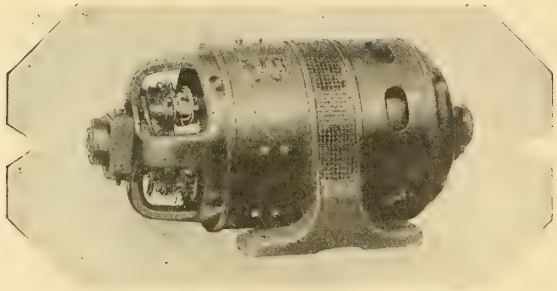
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RCA School Great Success; Plan Big Expansion

HAVING completed the first period in the course of instruction in the operation of motion picture sound reproducing equipment, which has been in progress in the class room of the installation and service department of RCA Photophone, Inc., No. 438 West Thirty-Seventh Street, New York City, announcement is made that the second period will begin on Monday, April 21st at the same place. As in the first period, the second will be for members of Local Union No. 306 and all projectionists who are members of the I. A. T. S. E. are invited to enroll. The entire course of instruction is offered gratis. Due to the fact that many members from distant points will be unable to attend, RCA Photophone is developing plans to carry these courses into every projection room in the country.

250 in First Class

Two hundred and fifty members of Local 306 took advantage of the instruction given during the first period which began on December 12th and closed March 26th. Sessions were held daily from 10 to 12 A. M. and 2 to 4 P. M. Harry Braun is Chief Instructor and he is assisted by A. R. Schultz, T. S. Jones, A. Preisman, C. G. Diller and Watson Jones. Nine hundred projectionists will be enrolled for the second period, the facilities

Television—Telephone

(*Continued from page* 38)

ly complicated and expensive," said Dr. F. B. Jewett, vice president of the American Telephone and Telegraph Company. "This complication arises out of the necessity for producing, transmitting and reproducing a large number of distinct images each second if good results are to be obtained. No practical suggestions for eliminating this fundamental requirement have as yet been made and there appears to be nothing promising in our present knowledge of physical science.

Correspondingly, the requirement is that in effect a very wide band of frequencies must be transmitted, leaving the transmission channel problem essentially unaltered. The requirement of an extremely wide transmission band, and the further requirement that during the period of transmission the channel or channels must have a high degree of electrical stability and freedom from extraneous interference, make the channel problem both difficult and expensive.

"Although, on account of its present complexity and high cost, no substantial commercial field is yet in sight for television requiring good images, there is still a large amount of technical work which gives promise of decided improvements."

of the class rooms having been enlarged to accommodate larger classes and the new equipment that will be installed. In addition to morning and afternoon classes, a session will be held from 8 to 10 o'clock each evening.

Comprehensive Course

Fifteen lectures covering the following subjects will comprise the second course: the nature of sound, elements of electricity, motors, generators, converters, storage batteries, battery chargers, synchronous and non-synchronous turntables, pickups, soundheads, control panels, transformers, the theory and operation of the vacuum tube and the vacuum tube amplifier, the push-pull amplifier, voltage amplifiers, power amplifiers, dynamic speakers, acoustics, RCA reproducing equipment, its care and operation, and how to shoot trouble.

Sixty members of Local 306 who enrolled in the first period during the closing sessions have elected to return for the second course of instruction.

Disc Reproduction Requires Constant Care

Many complaints of late regarding the needle jumping the record groove emphasize the need for careful attention to the details of disc reproduction. Instructions as to proper procedure to follow should the needle jump the groove are easily obtainable from the manufacturers of sound apparatus, and every installation should have an instruction book supplied for future reference. The procedure to be followed when the needle jumps the groove are outlined below:

If the needle jumps back the sound will repeat, and may keep on repeating at every revolution of the record. If the needle jumps forward, the sound will be ahead of the picture. The procedure will depend on the character of the film and on where the jump occurs. Any record on which the needle has jumped must never be used again, and the reproducer should be checked as soon as possible. Bring fader to zero immediately jump is noticed; the next procedure will depend on circumstances, as follows:

Where Exact Synchronism Is Essential

In this case it is not possible to continue without losing synchronism, and there is therefore no option except to continue program with next reel, which is set up on another machine, or else cut out sound for remainder of this reel.

Where Exact Synchronism Is Not Essential

Keep projector running, and look over reproducer quickly to see if there is any visible cause for jump, such as reproducer body dragging on record, or reproducer hitting something that prevents it from moving freely. If

(*Continued on next page*)

a BLARE,----a B-L-A-T

A WHISPER, or a

Spoils The Whole Show

The house with sound equipment that produces temperamental talkers—the kind that are dependably awful—shrieks, silence, BANG—is due for a visit from the sheriff.

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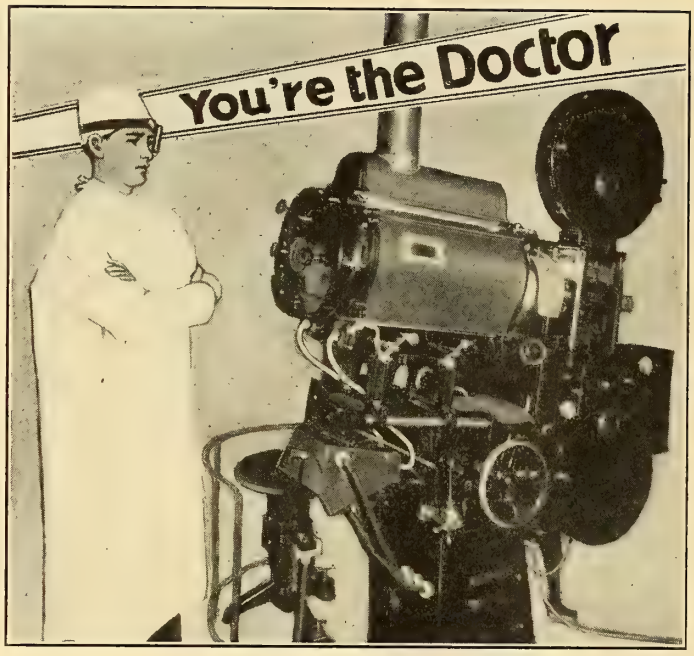
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Protests 'Blowing Up' of Sound Film Prints

Editor, M. P. Projectionist:

Sir:—The communication from Brother Charles B. Ludding of St. Paul, Minn., which you published in your April issue should be reprinted on a one-sheet folder and mailed to every exchange manager in the U. S. A. and Canada. What wonderful sound we get with a prima donna raising the roof with her singing (?)—and then, blooey! goes a long piece of blank film inserted in the sound-on-film print that gives the singer tones previously unidentified in her range.

This has happened to me many times, but that isn't the half of it. We receive all those wonderful lectures on how to care for prints so that they will last longer, with particular emphasis on the cutting of prints. Why don't the exchanges send out prints on 2,000-foot reels and thus eliminate any need for cutting? Instead, producers seem to take especial pleasure in "blowing up" their releases: take any picture approximating 10,000 feet and see if it is on 10 reels. Not at all. It is likely that it will be found spread through 12 or 15 reels.

"Blowing Up" Process

This "blowing up" process is responsible for a major portion of the blank film inserted into sound film prints, the idea being that the exchanges wish to maintain its full footage. It is simply impossible to run such prints.

Let's hear more about this practice and see if it can't be eliminated before wide film is generally used. I am sure that the exchanges would change their tactics if the matter was brought to their attention. If only there could be established some central bureau for the clearance of all such complaints, I am sure that a majority of the technical problems in both production and reproduction could be solved.—A. H. ESTES, Secretary Local 347, Columbia, S. C.

Disc Reproduction

(*Continued from preceding page*)

so, remove obstacle or change reproducer. This, of course, involves loss of accompaniment for remainder of reel.

If no cause for trouble is evident, then, if needle jumped back, change needle, move reproducer over to a position two or three grooves ahead of where it was when it jumped, and restore fader to its regular setting. If needle jumped forward, and if it now seems to be tracking properly, restore fader to regular setting.

Synchronism is lost when record is continued after needle has jumped, so in such cases if there are any direct cues in picture, such as knocks, voices, cheers, etc., fader must be put down to zero when passing over them.

Sound Picture Philology

ENVIABLY detached, movie men called their western pictures "horse opera." With gentlemanly ideals always uppermost, they dubbed the actor seeking undue prominence a "lens-louse." And now about the sound-picture also, there gathers the special language of the adept for his trade and the devotee for his art. The sound expert, when he travels in highbrow circles, styles himself an "acoustician." On the set, however, he is known, without loss of self-respect, by somewhat less complimentary terms. The sound-picture fraternity have developed a special vocabulary, brief as a ballet-skirt and no less expressive, for the complex ideas of their technique. Here are a few phrases, culled from various sources.

Apple—amplifier tube.
Blimp—sound-proof hood over camera. Also known as *bungalow* and *baby booth.*
Cans—headset sometimes used by the mixer operator.
Dubbing—re-recording of sound by electrical methods.
Freek—frequency (of alternation).
Flats—surfaces for construction of sets.
Gobo—light shield to protect camera lens.
Hards—arc lights for illuminating sets.
Inkies—incandescent lamps.
In Sink—in synchronism.
Mike—the Great Joss of the talkies —otherwise, the microphone.
Pan Stock—panchromatic film.
Pec—photoelectric cell.
Props—stage properties and the men who handle them.
Rushes—prints of the previous day's shooting, processed in a hurry for review. Also called *dailies.*
Soup—film developing solution.
Stew—undesired sounds.
String—light valve ribbon.

When something often done before must be done again right away, a wealthy noun and a gutty verb supplant the lengthy latinisms of leisure. Thus, at the shout "Lock 'em up!" camera men are consigned to their sound-proof booths. Orders for the steps in synchronizing cameras and recorders are: "Interlock" or "sink 'em." In a moment the word comes back "Sunk!" Final pleas to the actors for "quiet"—then "Turn 'em over." The return "Red light" means that cameras and recorders are up to speed. Action begins, to end with the director's shout "cut" at the close of the scene.

Local 342, Butler, Penn.

The following have been elected officers of Local Union 342, Butler, Penn., for the coming year: Howard Smith, President; Charles Lundunstadt, Business Agent; and C. S. Black, Corr. Secretary-Treasurer.

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THE electro-dynamic speaker was used long before cones or exponential horns were perfected, but it required more power for its correct operation than the amplifiers could deliver, until recent years when power tubes and other improvements enabled the amplifier assemblies to deliver so great an output that the dynamic type sprang into renewed popularity.

In one way it is an enlarged cone used for a diaphragm, but not as large as with the types distinctly referred to as "cone speakers." But the principle through which it operates is distinct and because this is the type of sound producing device most generally used with sound pick-up and sound amplification for auditoriums, it will be described.

Speaker Action

In principle, the action is somewhat as follows: A current-conveying conductor is placed in a magnetic field and thus are developed magnetic forces acting between and in relation with the magnet and the conductive element. When current is sent through a wire loop hung in suspension between poles of a fixed magnet, the loop will move in a direction and to a degree dependent upon the direction and the force of the current passing through it at that instant.

In the commercial types, such as the drive-element supplied for use with systems and installations like Movietone and Vitaphone, a strong enough field cannot be maintained by a permanent magnet, dimensional and other considerations entering into the employment, instead, of an electro-magnet. This field magnet has an iron headed, round core, and there is an air-gap or clearance between these members formed by a circular opening in the head, which opening clears the core all around, and across the two members is a strong radial magnetic field.

On a paper tube rigidly attached to the paper cone or diaphragm element, is found a coil of a number of turns of wire, and this cylindrical coil and its attached cone moves freely in its location in the ring shaped air-gap already noted. Perfect construction causes the coil on its paper support to fit as closely as possible in the opening without quite touching at any point of its circumference.

Flexible supports hold coil and cone element in this position with relation to the air-gap, both at the edge of the cone itself, where there is a thin leather edging affixed, and at the coil itself, so hung as to permit free and unbinding and unrestricted possibility of movement back and forth by the coil in the air-gap without letting it at any time touch the sides of the air-gap.

The coil of the artificially induced magnetic field is excited by sending direct current through it, as from a battery. When the amplifier delivers audio-frequency fluctuations, they are passed through the movable coil and, according to their strength and direction, they impart or cause in the coil a movement with respect to its horizontal position, to and fro, and the intensity of the coil current will govern the force with which the coil travels and, of course, with which the attached cone strikes again at or pushes the air—or draws back in the opposite direction.

Also, the frequency of alternation of the current-impulses governs in exact relation the frequency of these alternate periods of travel and their length. Thus is produced a movement which in energy release and in rapidity of recurrence corresponds to the amplifier current fluctuations; and since the coil is integral with the cone, that cone acts to impart corresponding movement to air particles and thus the wave length, recurrence frequency and intensitiy of the sound waves in their electrical counterparts is once more translated into air

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BLUE SEAL PRODUCTS COMPANY, INC.

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motion and a sound wave identical to that originally produced for recording is (or should be under proper amplification), the result.

Large Cone Objectionable

Because a large cone surface is liable to many objections, such as "paper rattle" and absorption of dampness due to inability to impart weatherproofing without creating a "crackling" surface, the small cone is utilized. But a small cone has the defects of a small diaphragm; it cannot radiate or respond sufficiently to low frequencies with energy enough to convey them as part of a balanced sound harmony.

Therefore, artificial means is resorted to in this and most all dynamic speaker assemblies: it takes the form of what is called a "baffle," which has the function of (simply expressed), preventing the escape of propelled air around the edge of the moving element.

In general, the rapid-flare or bell opening type of baffle has more benefit and less injury to tone than the box type. However, engineers should be called in to study the requirements, where real perfection of reproduction is considered a better investment than the difference in money saved by a home-engineered installation. The location of the horn or speaker itself (or of the units of a duplex installation) has much to do with the quality the elements will deliver.

Current Requirements

It is an attribute of the dynamic speaker in the sensitivity of its response to fine tone shadings, that the stronger the magnetic field artificially induced, the more sensitive will the receiver-element be and therefore the more accurate will be its effect.

Therefore, direct current of considerable wattage is needed, often from two to twenty or more watts being required for excitation of the field. If the current is held low a similar sensitivity effect must be gained in another way—by reducing the air gap between pole pieces and moving element (coil), with the resultant danger of clatter as heavy travel causes them to strike. Also, other difficulties of such a condition make the stronger field a more logical and at the same time a more useful means of obtaining sensitivity of a high order.

Storage batteries often furnish the field current: also, rectified current is used (A. C. rectified or changed to D. C.), through a suitable channel in the rectifier assembly for operating parts of the amplifiers themselves, or from independent sources. If rectified current of a small value be used to excite the field there must necessarily be a greater strength of current per impulse, from the amplifiers; while with a higher current value for field excitation, a somewhat closely

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Still more remarkable is the fact that thru fourteen years of this period, Hertner TRANSVERTERS have been supplying to Motion Picture Projectionists, the one sure automatic method of obtaining uniform current supply.

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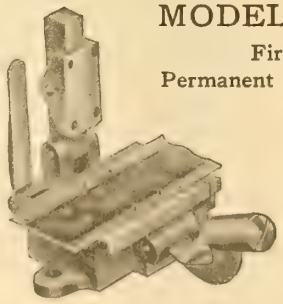
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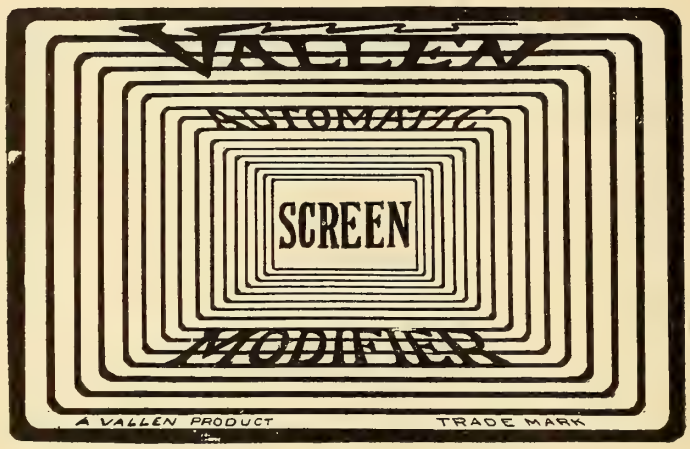


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corresponding reduction of the amplifier delivery to the receiver element of the speaker can be used.

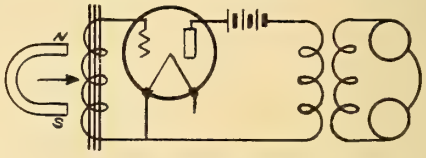
When the current for this excitation is taken from a rectifier element incorporated within the loud speaker itself, as with a rectifier tube, condenser bank or bank and choke coil to remove ripple from the changed current (ripples being due to the fact that in rectification of A. C. the pulses are evident even with full-wave rectifiers), there is a tendency to induce a coupling-hum in the elements of the horn-receiver itself. In the same way raw alternating current used for lighting valve filaments will pass into the circuit its own frequency and this, amplified, will often be noticeable unless proper adjustments are provided by which to eliminate it.

Advantages of Dynamics

The dynamic speaker has, however, more advantages than any other modern speaker for producing auditorium volume without distortion. It can handle a heavy current and thus a large intensity-of-sound production and has few inherent tendencies to distortion of its own except that its small cone tends to lose its grip on low frequencies, easily remedied by the correct baffle arrangement. Its principal bid from the technical side is that it does not change its impedance greatly with frequency change, so that it is by all odds the most distortionless when the whole audible frequency range is to be propagated, as in the performance re-creation of many types of voices and of large orchestras.

The Barkhausen Effect

While experimenting with vacuum tube amplifiers in 1919, a German physicist named Barkhausen discovered that under certain conditions a peculiar crackling noise was heard in the telephone receiver connected in the output circuit of the amplifier. The apparatus he was using is shown in the accompanying diagram. When-



By the use of the simple circuit above, the Barkhausen effect may be observed

ever the magnet was moved in the vicinity of the iron core, the sound was noticeable. After repeated experiments he concluded that changes of magnetization in the iron did not proceed uniformly but in definite small and uniform steps; that a minute portion of the core would suddenly change its magnetization and after a very brief interval another change would occur, and so on.

Since that time this discontinuous nature of the change in magnetization

Precise Series Resistance for Projector Starting

Many projectionists have trouble with the starting of projectors. Unless the motor starts slowly and positively, the projector and its associated sound equipment is subjected to severe strain. Some equipment manufacturers provide fixed series resistors, but these often fail to provide the correct resistance value, and may even fail to stand up under load.

Recently consulted on this problem, the engineering staff of the Clarostat Manufacturing Company, Brooklyn, N. Y., recommended the Super-Power Clarostat—a giant adjustable resistor providing a wide range of resistance in several turns of its knob. Tests have confirmed the soundness of the recommendation. Employed as a series resistance, the clarostat may be set for any satisfactory value to insure the slow, positive starting of the motor, minimizing the strain on the projector and associated sound equipment. A three-point snap switch is employed for turning on and off the current, and inserting or eliminating the clarostat resistance from the motor circuit.

Once the satisfactory resistance value is determined by actual test with the particular motor to be controlled, the clarostat is left alone, maintaining that resistance setting with the certainty of a fixed resistance. Meanwhile, the 250-watt capacity of the device is more than ample to dissipate the heat generated. Both snap switch and clarostat may be mounted in an iron box, or the device itself may be mounted in a separate box.

Electric Clocks

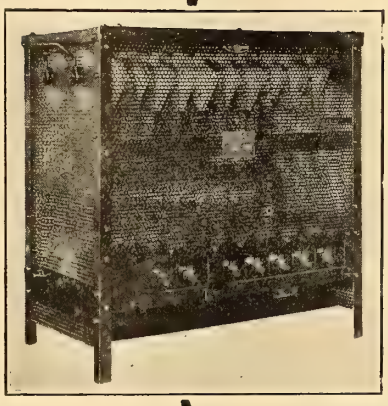
Telechron clocks, a product of General Electric, are now being distributed by National Theatre Supply Co. These clocks, which operate direct from electric circuits of the usual voltages, are operated by a small electric motor. They are said to require no winding, regulating, or cleaning.

Such a clock is a projection room necessity, in order that there may be no divergence from set schedule in picture presentation and to provide an accurate check on running time.

has been known as the Barkhausen Effect.

The approach of the permanent magnet in the illustration produces a change of magnetic flux in the soft iron core and as a result an electromotive force is generated in the surrounding coil of wire. The motion of the permanent magnet is made continuous, without any sudden changes in speed, and if the change of flux were equally regular, no sound would be heard in the receiver. Barkhausen's experiment indicated, therefore, that at least part of the flux changed suddenly or discontinuously. —R. M. BOZORTH in *Bell Record.*

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AS the name implies this new construction offers the projectionist everything he has been looking for; two focal lengths in one construction.

By rotating the ring on the lens mount the size of the image on the screen can be increased or decreased instantly to take care of the difference between sound and silent film. At the same time an automatic shifting of the center of picture on screen with sound film is provided for.

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Let us know your preference, please. All requests will receive attention in the order of their receipt, so act quickly. Use the blank below to tell us in just what subject you are particularly interested. Do it now!

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Vallen Offers New Automatic Screen Modifier

CONSUMMATING two years' experimental and development work, the Vallen Electrical Company of Akron, Ohio, has perfected and now offers the Vallen Automatic Screen Modifier for changing the screen surface in connection with large pictures. In keeping with the Vallen policy of anticipating forthcoming demand, much time and money has been devoted to the development of this particular device. However, sale of the device was withheld until such time as it would pass the most rigid specifications as to practicality, compactness, and dependability. Now this modifier is being marketed under the same policies of service and guarantee for which the name Vallen has stood.

At the present time the demand for this modifier is being keenly experienced in conjunction with what is termed "magnascope" projection. The Vallen Modifier embraces in design every feature to permit its use in connection with Grandeur film at such time as this particular application may be desired.

The Vallen Modifier consists of a metal screen frame, rigidly designed but not excessive in weight, and inside of which the screen is laced. To this frame is attached the equipment for handling the black velour curtains which modify the screen surface in any desired direction and any desired extent. Of vital interest is the fact that no additional space is required beyond size of the frame.

The device is a complete unit. In other words, the various parts are all attached to and a part of the metal frame. Without any change, the unit can be made to "fly" when desired. All driving, or movement, is accomplished by means of chain, thus eliminating all possibility of slippage or irregular modification of the screen surface. Operation may be manual or electrical.

Full particulars of this new device will be sent promptly upon application to Vallen Electrical Co., Akron, Ohio.

Elkhart Examining Board

A bill pending before the City Council of Elkhart, Indiana, provides for the examination and licensing of projectionists by a city board of projectionists. This board would be comprised of the city electrician and two projectionists appointed by the mayor for two year terms. Examinations would be held at intervals of three months.

Provision will be made that no one under 21 years of age should be licensed. Further, a license will be necessary for the operation in any place of assembly, public or private, excepting toy machines or small projectors using non-inflammable film and having a light source not exceeding 100 watts.

Hints on Film Storage

STORING of film requires the utmost precaution. The film must not get brittle through lack of the proper moisture. Nor, on the other hand, must it be allowed to become too moist, for then it will stick together and ruin the print. If the film becomes dry and brittle, it weakens the sprocket holes so that they eventually break down, and it also causes the film to crack.

If it becomes too moist the emulsion becomes sticky and separates from its base. This is what happens. The non-emulsion side of the print has a covering of hardened gelatin. The emulsion itself has a gelatin base filled with silver particles. When the emulsion is in a moist state it is forced against the hardened gelatin of the non-emulsion side (we are now referring to the print wound on a reel), and the two coatings adhere. When the film is unwound and separated from the next layer the emulsion loosens and sticks to the layer next to it.

Therefore, the utmost care must be exercised in unwinding the print. The layers must not be separated by jerking or pulling but should be coaxed apart so as to cause as little damage as possible. This damage, however, will occur when the print runs through the projector, if the print has not been properly stored beforehand. The loosening of the emulsion will not be noticeable during the first several showings of the print but it will gradually show up and compel the discarding of the print.

The prevention of this lies in the proper adjustment of the moistening chamber in the vault or safety cabinet used for film storage. The lack of proper storage conditions may do damage to the film in the area of the sound track which will require the elimination of the damaged part and thus break up the logical continuity of the sound. A few cuts of this sort may pass unnoticed, but if they accumulate during the course of a single subject the audience will become aware of them.

A Modern Terror

In reviewing a sketch in a recent Paramount production the motion picture critic of The New York Sun passes the following comment:

5. "In a Girls' Gym." Jack Oakie is the instructor of the "Venus girl" class and Zelma O'Neill is his jealous sweetheart. "I'm in Training For You" is the song, and the number, as a whole, is so so; but whoever directed Miss O'Neill and Mr. Oakie in such discarded, unfunny song and dance routine should be locked up in a projection room for life.

It being this reviewer's idea, apparently, that being locked up in a projection room for life is comparable to being consigned to a medieval dungeon or being tossed to the lions.

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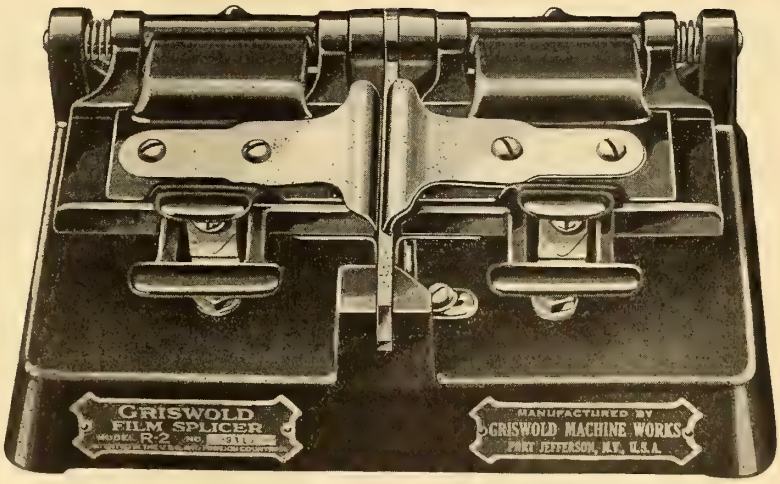
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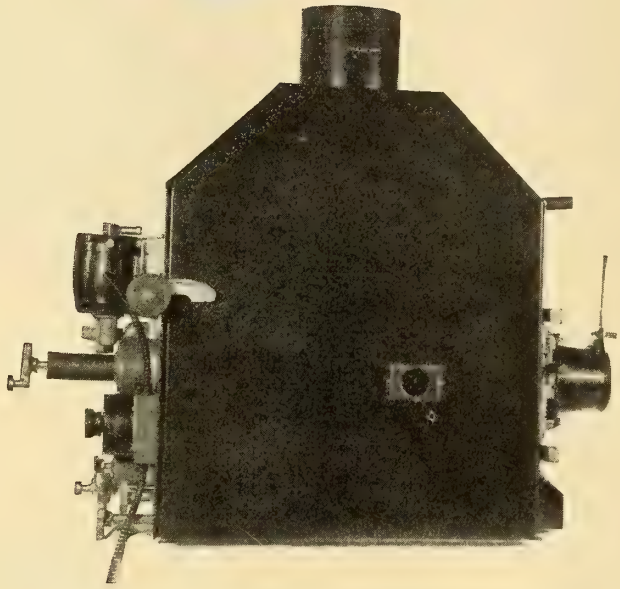


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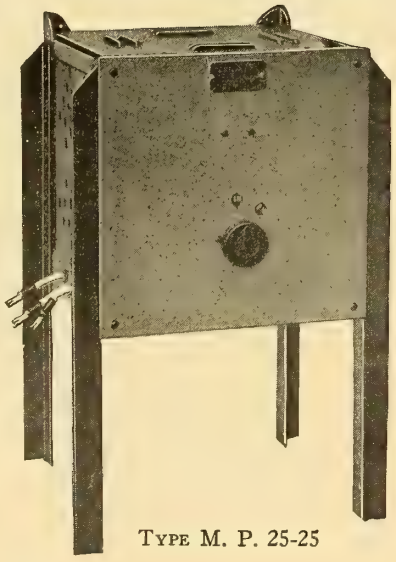
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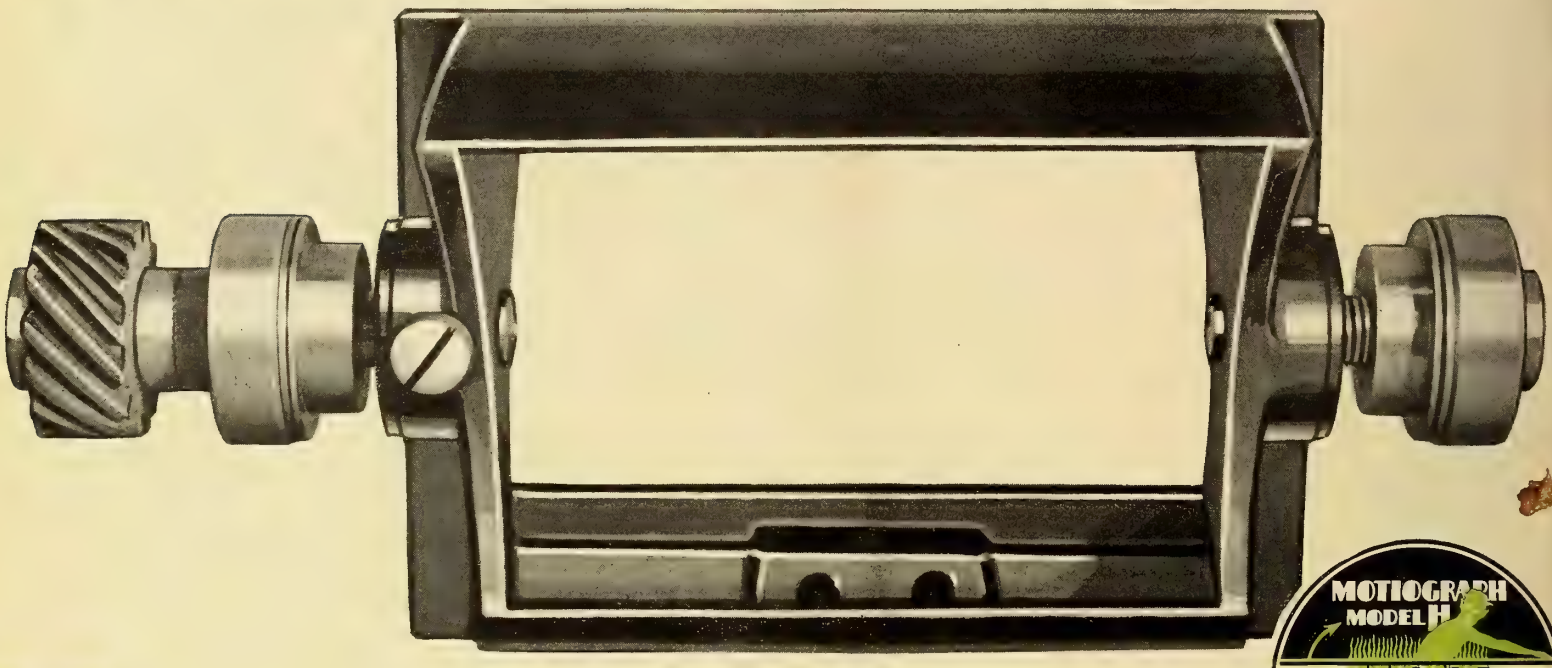
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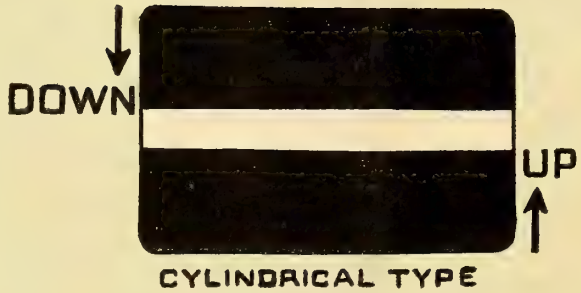
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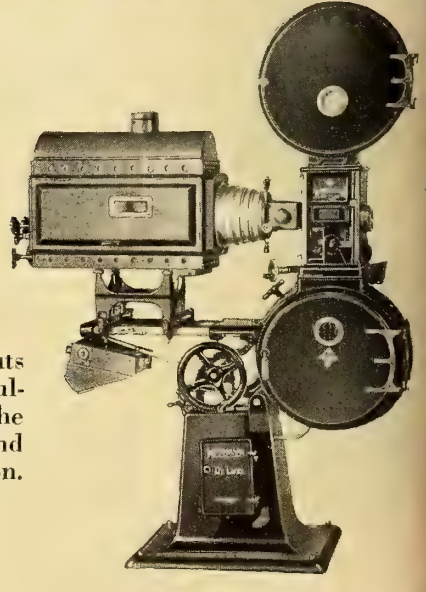
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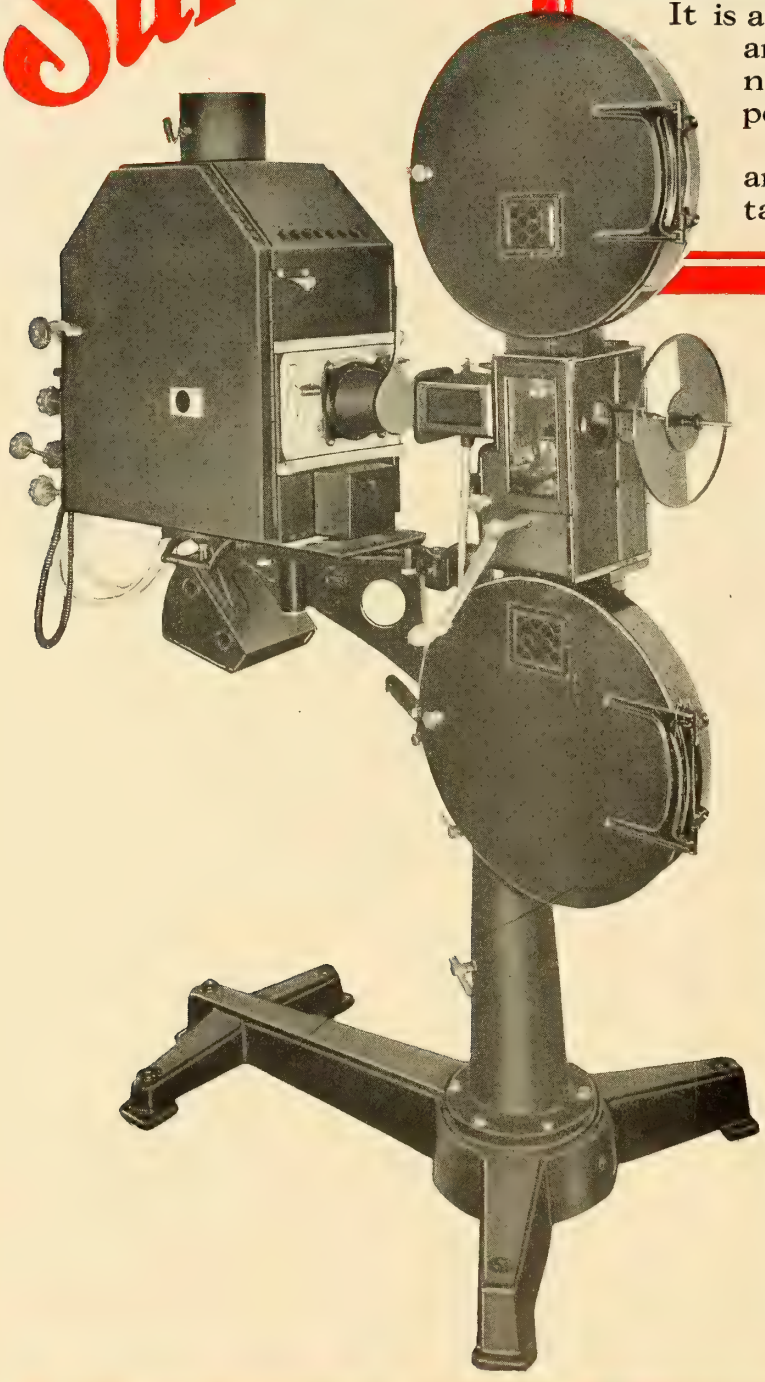
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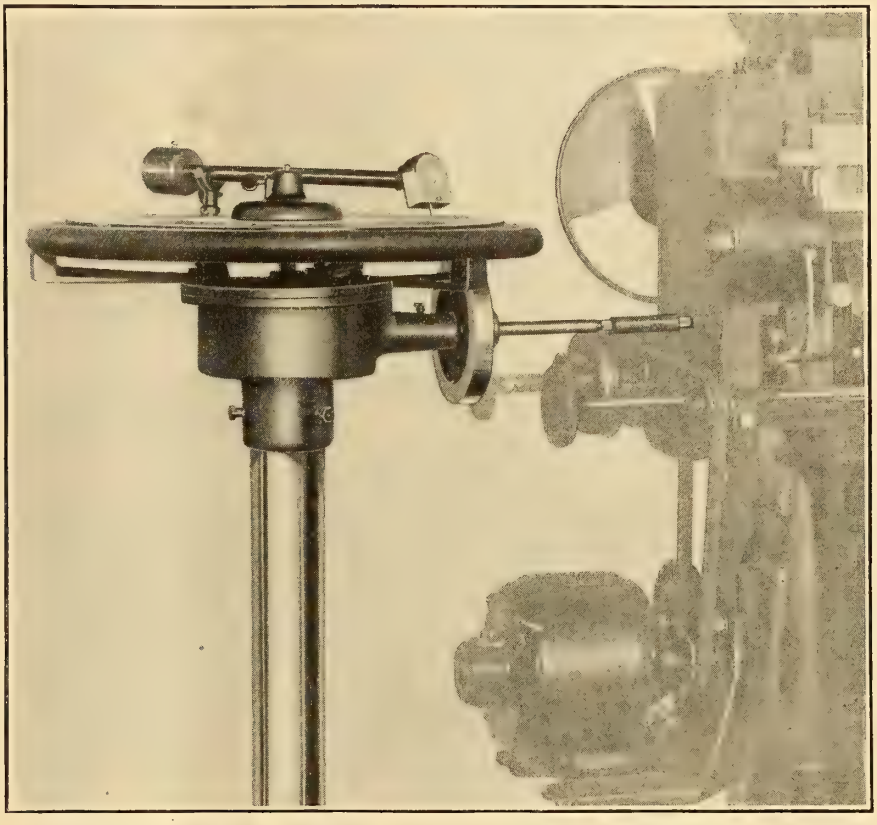
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For every small house in the land—including the Saturday night and Sunday movie hall—here is the new and wonderful "life-saver" by Weber. *Every movie can now be made a "talkie."*

Think of it, for $150.00 per pair, including pick-ups and change-over fader, you can have two Syncrodisk Junior Turntables, built absolutely with the world-famous Weber precision, accuracy, care and quality. Faultless, synchronized talkies for $150.00.

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It is the only screen optically and chemically correct for the projection of Colored Pictures.

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MOTION PICTURE PROJECTIONIST

June, 1930 Vol. 3, No. 8

JAMES J. FINN, Editor

Frank R. Day, *Personnel;* Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* Arthur Gray, *Conservation;* Rudolph Miehling, *Sound;* John Kieley, *Equipment;* Samuel Wein, *Research;* R. H. McCullough, *Studio Contact;* Harry Rubin, *Improvement.*

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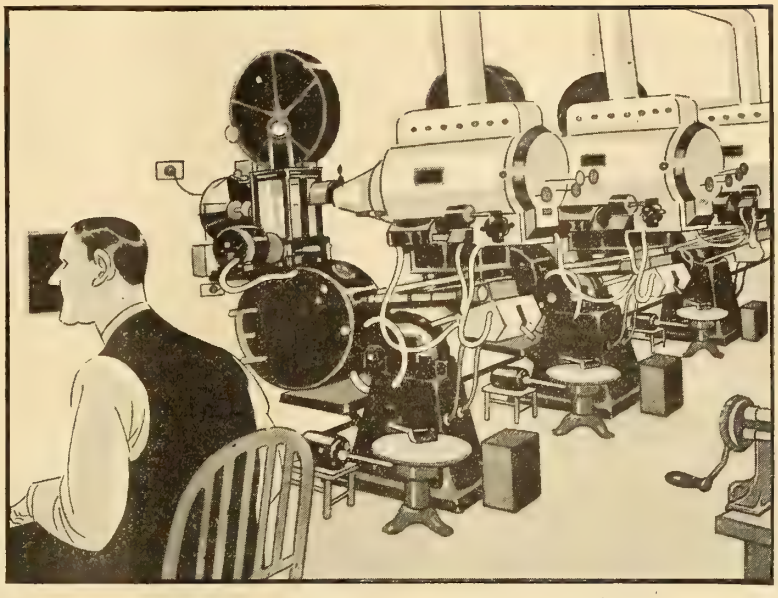
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The natural color film problem has been solved by a recent Swiss invention, states the *Swiss Cinema,* a trade magazine. A color film produced according to the new process was recently demonstrated. The colors appear to be absolutely natural and give a greater impression of plasticity than was ever produced by a black-and-white film. The new invention does not imply either technical or financial difficulties; it is merely a completion of the black-and-white film. Films produced according to this process can be projected over any ordinary apparatus and copied and developed along the usual lines.

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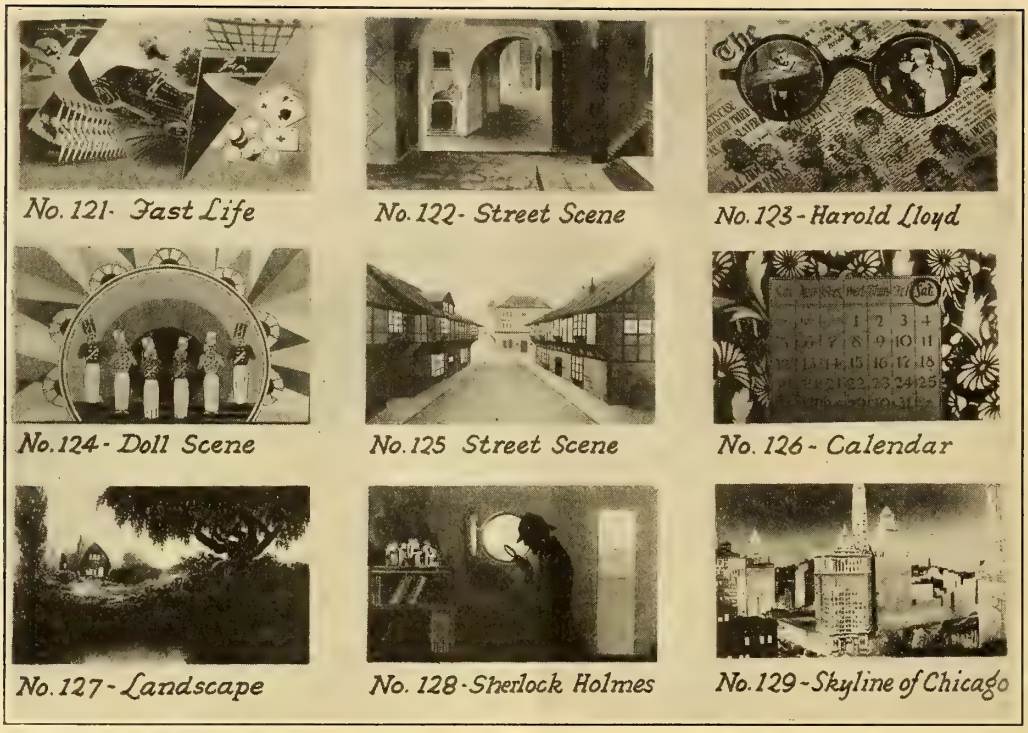
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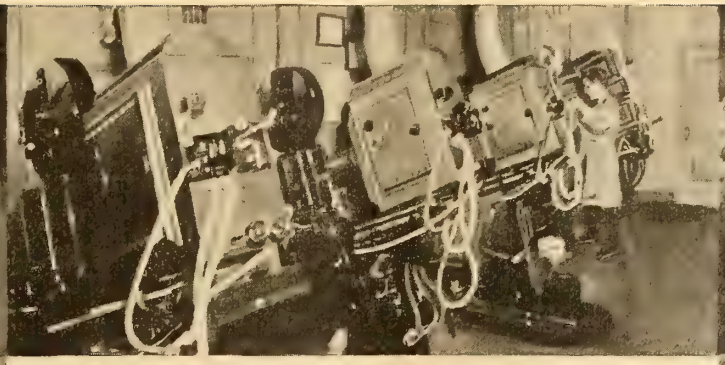
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Oak Trees
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Circus Tent
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Lillies and Candles
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Doll Scene
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Sherlock Holmes
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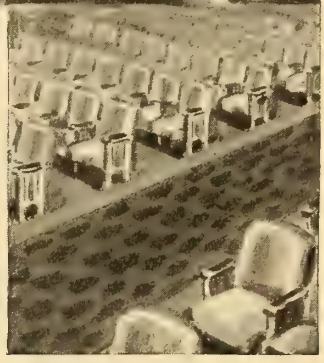
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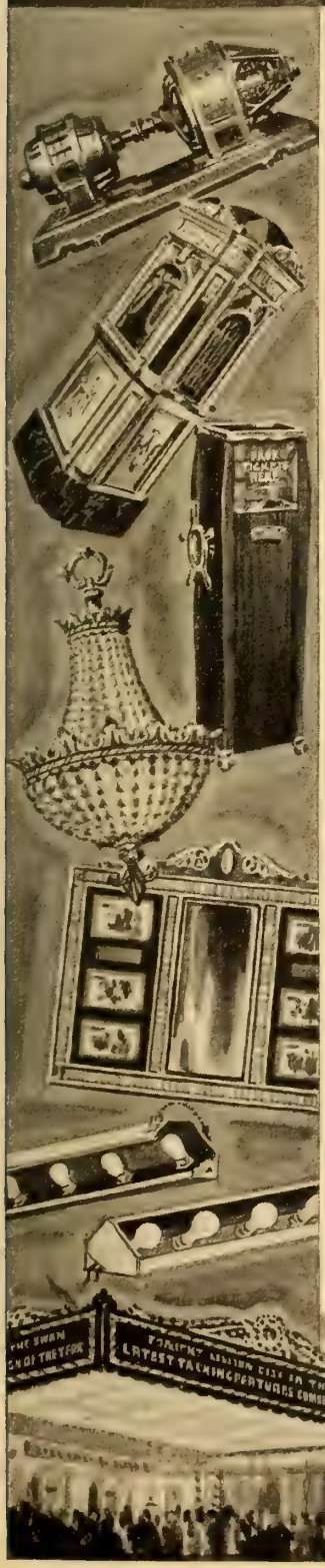
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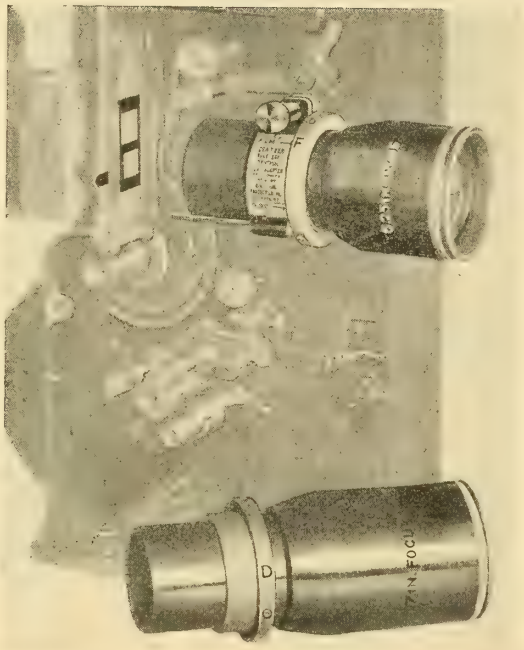
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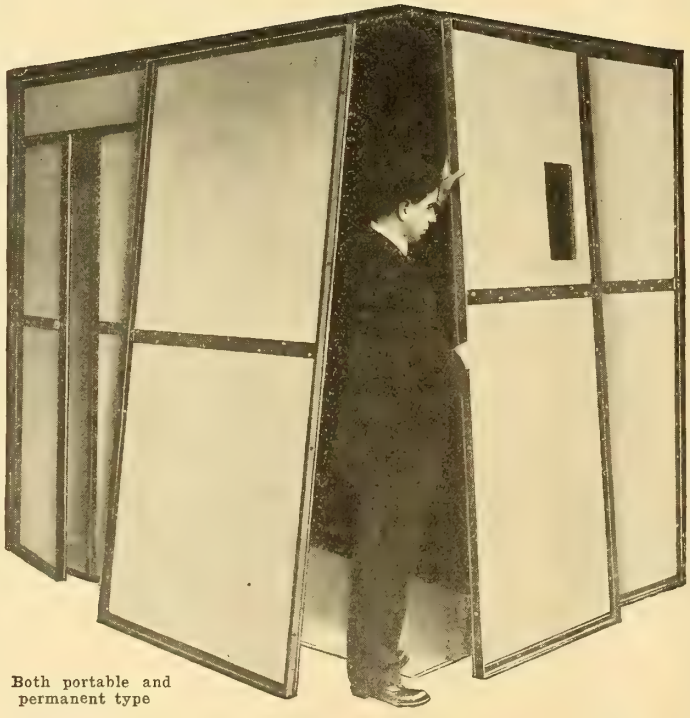
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We Build

PORTABLE

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As the motion picture industry was just beginning to get under way, it became necessary for the Johns-Manville Company to have this work done by iron workers, who were furnished with the asbestos boards to complete the booths.

For the past two years these booths have been built by the Blue Seal Products Company. We have installed all the necessary machinery for cutting transite board, and equipment for cutting and bending angle iron, and have a floor space large enough to build many booths at one time. These booths are erected on the shop floor and panels marked before shipment is made to the theatres.

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FOR THAT SMOOTH START...

SNAP—the projector starts, slowly, surely, without strain. Another snap—the projector is now up to speed, projecting flawless pictures accompanied by perfect sound.

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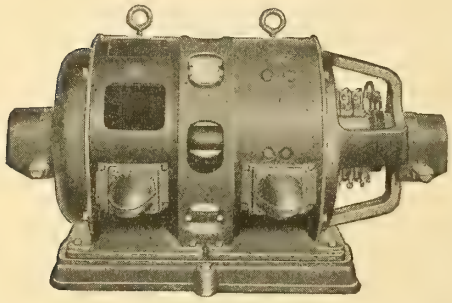
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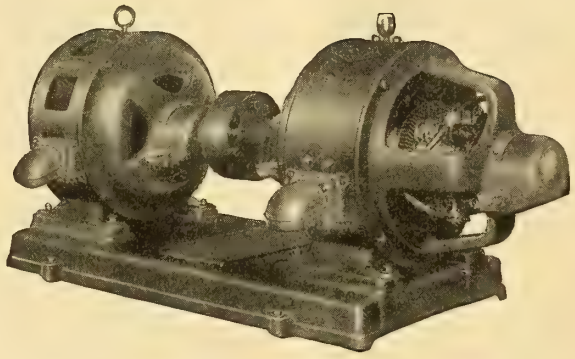
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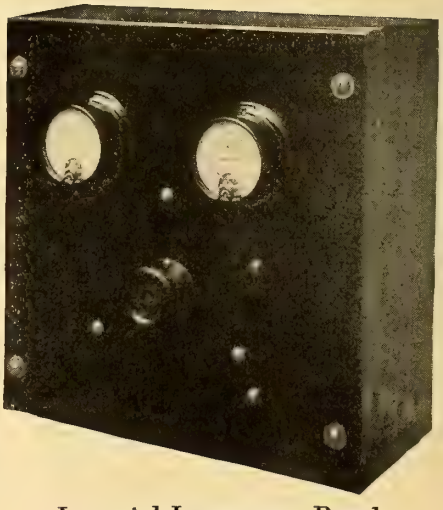


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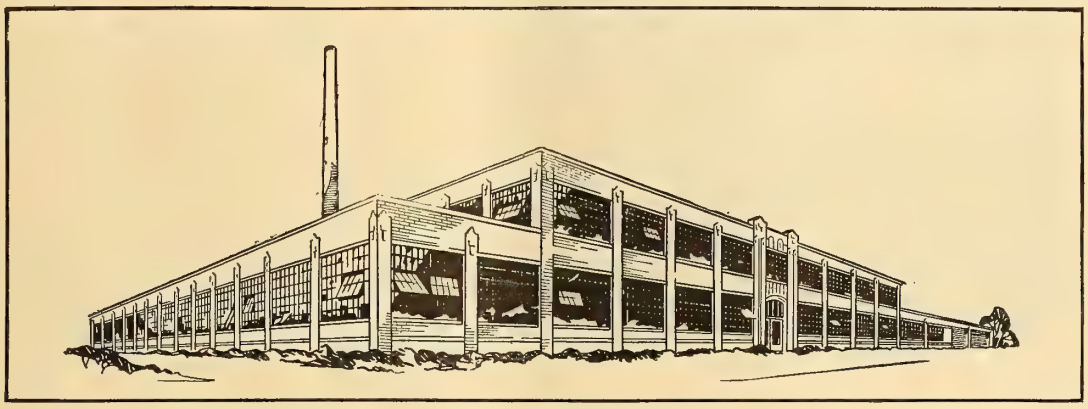
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Many a theatre where the sound goes over biggest with the customers nowadays is one where correct but little-known electrical principles have been ingeniously applied—as for example in the manner of connection of speakers to the amplifier.

Silver-Marshall engineers are masters of speaker location and wiring—for not only are Silver-Marshall auditorium speakers pre-eminent in their fidelity of reproduction, but Silver-Marshall audio transformers of all types have been leaders in quality since 1925.

Extremely interesting, both from the economy and performance standpoints, are some of the recent practical discoveries of our installation engineers. Why not write and get, without cost or obligation, the benefit of their years of experience in sound problems?

New Silver-Marshall Auditorium Speakers



These new speakers are the result of a determination on the part of Silver-Marshall engineers to provide a speaker actually capable of delivering to your patrons the most perfect tone fidelity that modern amplifiers can preserve.

They are built by pioneer speaker designers to reproduce the most delicate coloratura soprano, or the thunder of artillery in warfare, as faithfully as they do ordinary dialogue.

The new Silver-Marshall auditorium speakers are available at extremely moderate cost, to fill the requirements of any theatre, no matter what its size and shape, no matter what type of amplifier is used. The proper selection, location, and method of installation of speakers is an important part of the service offered by Silver-Marshall sound engineers.

Tell Us This About Your House

Silver-Marshall engineers will cheerfully make recommendations for your theatre without charge. They must know the following:

1. Length, width, and seating capacity of house.

2. Amount and type of absorbent material ("felt," drapes, carpets, type of seat upholstery).

If house is already wired, following should be stated also:

3. Make and type of amplifier used.

4. Make and type of speakers now in use.

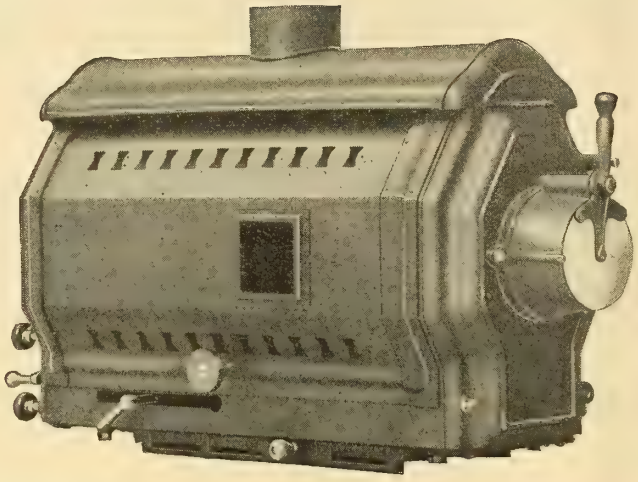
5. Does amplifier operate directly into voice-coil circuit of speaker (or is a speaker input transformer used)?

6. Faults of present reproduction—such as: "Boomy"? "Barrel-like"? "Nasal"? "Sharp"? "Tinny"?

Write us now—see suggestions above—at right
Kindly address the Chief Sound Engineer

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Adapt Rear Shutters for Regular Simplex

By H. E. GRIFFIN

The following information supplements a complete description of the new Simplex rear shutter which appeared in these columns in a recent issue. Rear shutters are now generally regarded as delivering the most efficient projection results, and both Motiograph and Simplex projectors now feature this unit. The adaptation of the new rear shutter to all Simplex models is a real forward step.—The Editor.

TO meet the needs of theatres in which are installed the regular model Simplex projector, International Projector Corp. has designed a new rear shutter assembly similar to the one furnished with the new Super Simplex. This assembly is attached to the regular Simplex mechanism and is identical with the one on the latest models. This new assembly includes many features found only in the Super Simplex, such as the new type gate opening device, eye shield, new type framing device, pilot lamp assembly and shutter adjusting mechanism. All these are manipulated from the operating side of the mechanism.

Porous Screen Light Loss

The advent of sound pictures made it necessary to discard the old type opaque screens and substitute therefor various types of perforated screens so that the sound might be more satisfactorily transmitted through the screen. Porous screens have reduced the light from 25 to 40 per cent., necessitating the use of much higher amperage in order to bring screen brilliancy back to somewhere near normal. The result of this increased amperage has been a greatly increased amount of heat at the aperture plate and over the front of the mechanism. This not only caused warpage and damage to the rear of the mechanism but also developed a great deal of buckling of the film and a corresponding amount of distortion of the sound track on the film. The former is readily visible on the screen and most annoying to the observer. The latter has not been so obvious, but it can be readily appreciated that sound waves photographed upon the film cannot possibly reproduce with proper fidelity the excellent results obtained in present day recording. The elimination of these two defects has naturally been of great importance, but the fire hazard which developed through the use of higher amperage was far more serious. It has been thoroughly realized that the film has never been adequately protected by cooling devices during its transit through the projector, but due to relatively lower amperages and various protective devices on the projector the fire hazard

4 different Changeovers One for every type projector

** All equipped with the famous treadle-type foot switch.*

1 **STRONG 5-POINT CHANGEOVER,** for Simplex or Motiograph, includes the following features:—eye shield, framing light, film gate opener, and changeover.

Now equipped with automatic cut-off. You can't burn the coil out.

Price: {**$60. for Simplex** / **$55. for Motiograph**

2 **STRONG SUPER CHANGEOVER** for Super Simplex. Takes the place of the eye shield.

Equipped with automatic cut-off.

Price: $50.

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Equipped with automatic cut-off.

Price: $65.

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You Can't BURN OUT Coils in

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CHANGEOVERS

(*A PATENTED FEATURE)

ALL models of STRONG Changeovers, except the *Junior* type, are now equipped with *Automatic Cut-Outs.* Cuts current off coils immediately changeover is made.

STRONG Changeovers are acknowledged the *best.* And with good reason: For many years STRONG has specialized on the development and manufacture of changeovers only. Years of experience *in the projection room as a practical projectionist* has enabled us to observe, study, understand, and finally solve the many changeover problems that arise through changes in types of projectors and special conditions of various projection rooms. We have consistently kept pace with progress. Today our four types of changeovers satisify *all* conditions. One of these will solve *your* problems.

JOIN the procession. Join the thousands of theatres now using STRONG Changeovers. Write us —or see your nearest National Theatre Supply Co. branch.

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has not been a particularly serious problem.

With the introduction of sound the greatly increased amperages aggravated the hazard to such an extent that fire authorities throughout the country have become very much interested in the matter. The problem, however, has been satisfactorily solved by the introduction of the rear shutter. Exhibitors are now enabled at very low cost and little or no trouble to equip their projectors properly and protect the film from excessive heat. The same equipment also solves the problem of buckling and sound distortion because these troubles were due primarily to the excessive heat heretofore projected to the film.

Attempts have been made in various ways to reduce heat and eliminate buckling, but the results have never heretofore been satisfactory. The most successful efforts to overcome this serious problem have been coincident with the introduction of the rear shutter. New model projectors, of course, have these rear shutters, and now it is possible for users of prior model projectors to equip their machines at less cost and little trouble with a new rear shutter which will give just as efficient service as do the new model projectors. This adaptation of a new assembly to existing models is a great forward step.

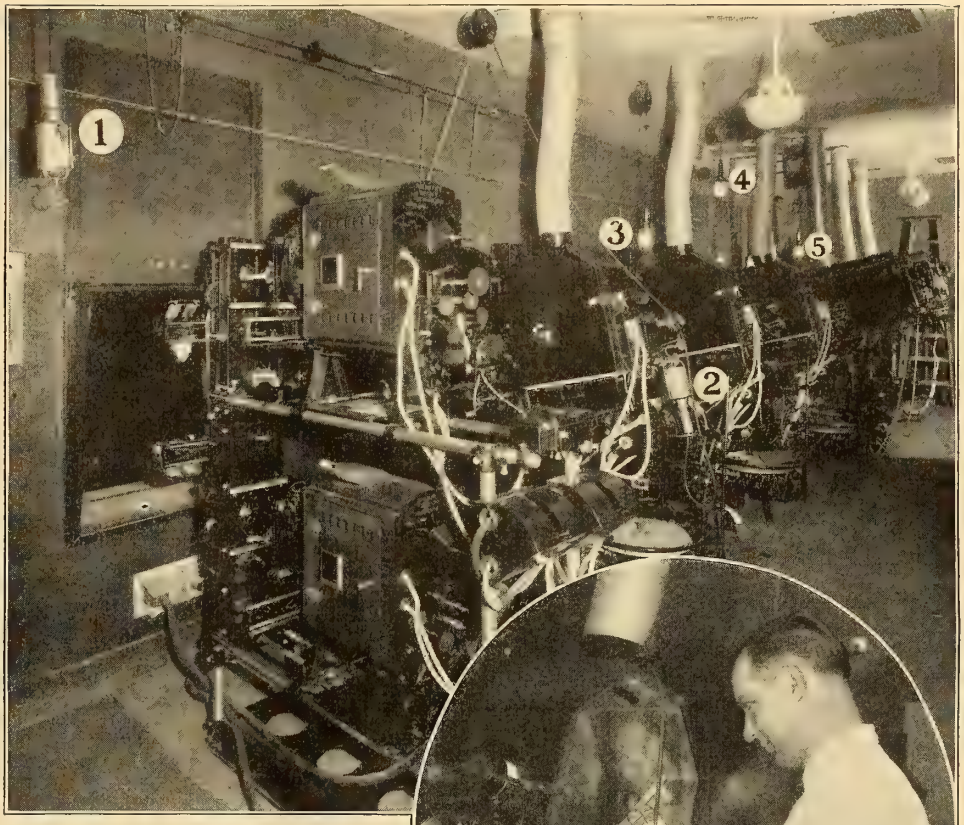
The rear shutter assembly entirely meets the exacting demands of present day projection by providing more light and at the same time reducing the heat at the aperture. Illumination is increased greatly, the percentage increase depending on the focal length and type of lens used, and the heat at the aperture plate is reduced to between 50 and 75 per cent.

Eliminates Heat

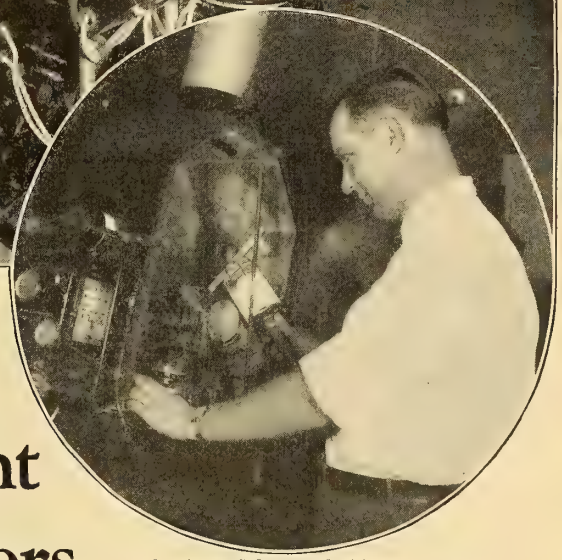
This improvement is due to interposing the new shutter assembly between the arc lamp and the film, thereby making it unnecessary to use heat plates or shields in proximity to the film. The blades of the new Simplex shutter assembly in their new position immediately eliminate 50 per cent of the heat from the arc and, in addition thereto, a further large decrease in heat is obtained by using this shutter to create a partial vacuum at the aperture and set up an air disturbance in the beam of light which accomplishes the desired result. The air current set up by the shutter will keep the film cool and therefore prevent buckling. The width of the rear shutter blade no longer depends on the size of the lens so that a shutter using a 90 degree effective blade can be used with a lens of any diameter, while with the old type shutter a minimum of 102 degrees was necessary.

The assembly as above stated may be attached to any existing old type Simplex mechanism and in a very short time.





Photograph of projection room, Loew's King Theater, Brooklyn, N. Y. All Loew's theaters are Reelite equipped.



Mr. George Johnson, Chief Projectionist, using REELITE.

Reelites are standard equipment in modern theaters

REELITES are low in cost, are out of the way when not in use and add greatly to projection room efficiency. They are used in thousands of theaters throughout the country.

REELITES may be hung over every projection machine, within easy reach in emergencies. In the photograph above, REELITE No. 1 is used to light up the surrounding area as an ordinary electric light. No. 2 shows it hung on the lamphouse to light up a particular area. No. 3, No. 4, and No. 5 show other REELITES swung out of the way of the working crew. The projection room shown in this photograph has a battery of five REELITES.

REELITES can be swung into instant action. Just reach your hand above your head and pull it down —a slight pressure on the button and the light shines right where you want it. The long cord, winding out of the housing fastened to the ceiling, enables you to walk around the projection room freely carrying the light with you where necessary. When finished, it will wind itself automatically back out of sight.

Visit your city's latest theaters and you will find REELITES. You should have them too.

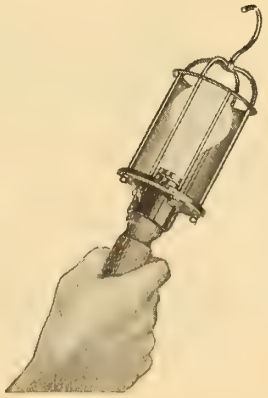
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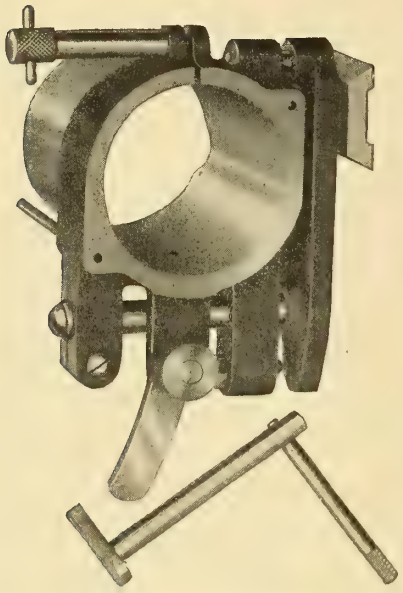
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The Handy Light on a Reel



MODERN PROJECTION NEEDS



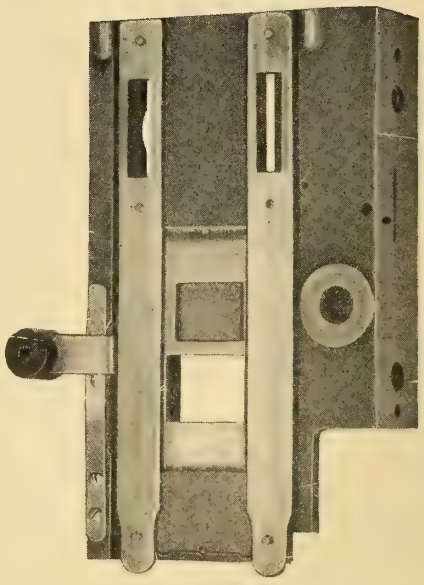
Centering Lens Holder

The Centering Lens Mount for Simplex, here illustrated, is endorsed by projectionists everywhere as the simplest, most accurate and efficient device for effecting instantaneous lateral adjustment of lens when changing from regular to sound track film and vice versa. Can be placed in machine in a few minutes without cutting or machining. Holds lens rigid and vibrationless.

Price each complete as shown—$25.00

The Duplex Aperture Gate for Simplex carries a vertically shifting plate having both the regular aperture opening and also one for movietone. The sound on film aperture may be either proportional or one which simply masks off the sound track, as you prefer.

Price each complete as shown—$35.00

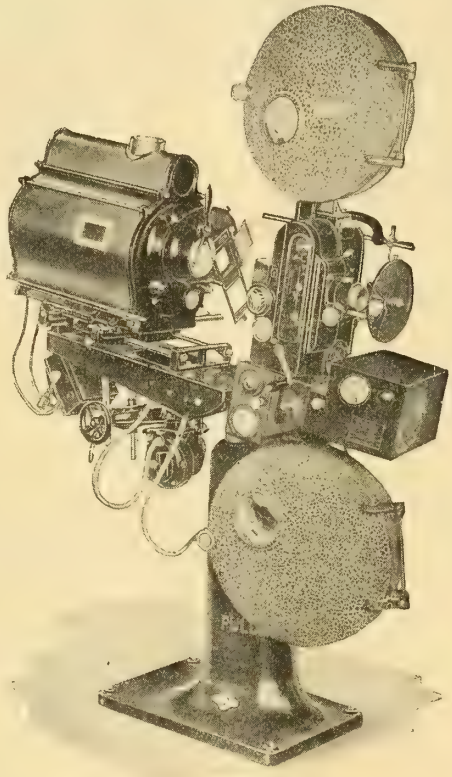


Duplex Aperture Gate

Replacing intermittent unit requires only a minute. Should emergency require it, replacement can be accomplished without interrupting or delaying show in the least.

THE GEM CARBON JAW is designed expressly for use with the ***Peerless High Amperage Reflector arc lamp.*** Made of a special heat resisting alloy which will outlast any material now in use for this purpose. Type of construction insures carbon being held parallel and positive crater is always precisely at focal point. Because of lasting qualities it is by far the most economical carbon jaw to use.

PRICE ea. $12.00



The FULCO PROJECTOR is notable for many exclusive features of real practical value.

One of the most important of these is the replaceable intermittent unit.



PRICE each $12.00

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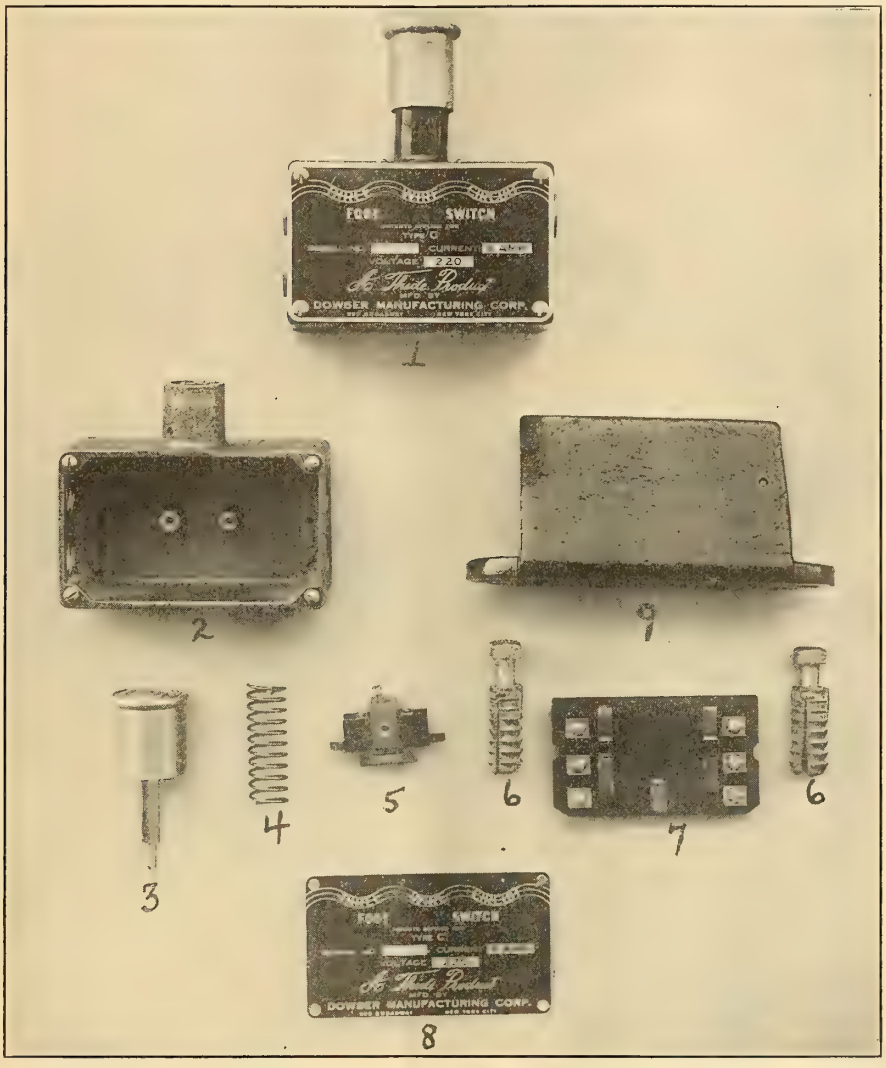
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2. Casing
3. Plunger and shaft
4. Plunger recoil spring
5. Plunger contact assembly
6. Bracket mounting screws
7. Panel assembly
8. Cover
9. Floor mounting bracket

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3-WIRE CIRCUIT FOOT SWITCH

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It permits the simplest installation both in mounting and wiring—also the easy replacement of parts.

Entire switch mechanism is mounted on a bakelite panel.

All contacts are of phosphor bronze wipe contacts, and are large enough to carry more current than will ever be needed.

The panel has binding posts to which wires may be fastened, thereby eliminating all soldering and splicing.

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It has a square plunger shaft with bearing an inch long, which prevents binding and allows for ease in operation.

A floor bracket especially designed for use with this foot switch places the switch in the proper angle for smoothness in operation by the projectionist.

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A REVOLUTIONARY ACHIEVEMENT

THE GoldE Unilens Method for projecting all types of sound and silent film with one lens provides one size projected picture on the screen *at all times.* The means for accomplishing this purpose do not employ any Prisms, Bi-Focal lenses, or Eccentrics—which are all trick gadgets. Instead, the elemental optical laws are followed. Explaining the method simply, we find employed:—

An aperture of the new S.M.P.E. Standard size—.600″ x .800″
A Lens Mount as carriage for ONE lens.

The aperture plate is mounted in the Simplex E-16 for movement sideways, the movement being supplied by outside lever. The movement from one side to the center is approximately .047″, which movement is sufficient to cover the sound track at one set position; and on other stop setting, centers the aperture *exactly* on the center of Vitaphone and silent film.

In centering the aperture in this manner on disc and silent film, we find a very slight cut-off on top, bottom and the sides. We also find that this cut-off is not objectionable—even the largest titles are not interfered with—due to the *exact centering* and the relation of the aperture.

Having only one aperture — we need only one lens!

Therefore—mounting the lens in the GoldE Unilens Mount — we shift lens and aperture in exact relation to each other. Thus, for projecting sound-on-film, the aperture is shifted to cover the sound track—*exactly, positively*—in one set position. The lens is at the same instant shifted in exact relation to this position—to stops pre-set at time of installation. In this way the lens is always in central optical relation to the aperture. For projecting disc and silent film, the aperture is shifted by means of outside lever to other set position—the lens is shifted to stop by means of outside lever, and both aperture and lens are again in exact relation to each other. Thus, the screen is always covered exactly and fully with one size picture—*of horizontal proportionate shape.*

It can readily be seen, then, that with the GoldE Unilens Method all manner of film may be coupled indiscriminately—the shift from one type to the other is accomplished in tenths of seconds—too fast for the eye to notice the change on the screen! Disc shorts may be followed by Movietone trailers of all types coupled in one reel—yet the projected screen image is always one size—*exactly centered in screen masking!*

The GoldE Method has become the new standard for projection . . . because it is the simplest and most positive and because it is the most practical for projectionist and theatre.

GOLDE
UNILENS METHOD

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Gives Equal Size Pictures *from*

SOUND-ON-FILM
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Using

GoldE Unilens Mount
With Your Present Lens
Plus
GoldE Aperture Plate
And Nothing Else!

No Bifocals **No Prisms**
No Fuzz **No Hokum**

The Marvelously Simple And Simply Marvelous Sensation of Projection!

See The
UNILENS METHOD
In Use at the Convention

Projectionists who once use the Unilens Method refuse all others. Now in use in many chains and boosted by all. Ask around and get a few personal experience stories from those at the convention.

Pictures projected by the Unilens Method are always centered on the screen with full coverage between masks. Even the largest titles on present films are not cut.

One little tap on two little levers changes from Vitaphone to Movietone or silent film. Instant action—so fast all three films can be alternated on one reel and the audience never suspect.

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Greetings to the Chief!

30th I. A. Convention

WHEN the more than 1,500 delegates and guests at the forthcoming General Convention of the I. A. T. S. E. & M. P. M. O. U. assemble for the first meeting they will very likely see presiding in the chair a slender, bespectacled and altogether unassuming looking gentlemen who will from time to time respond to the call of "Mr. President," but who will otherwise give no indication that he is the leader of one of the most powerful and best organized labor bodies in America—or anywhere else, for that matter. Nor will there be forthcoming from this particular presiding officer any indication that he might be in any way responsible for the splendid condition of the great organization which he heads.

But the Convention will not be long underway before it will be quite apparent to even the unitiated visitor that the presiding officer is no commonplace individual, no ordinary gentleman so common to American business organizations, and certainly not of the type popularly conjured up by the general public as typical of a labor leader. His quiet dignified manner of conducting business; his ability to attract and hold indefinitely the attention of large gatherings; his sparkling wit; his ease in deportment—and above all, his amazinging knowledge of everything even remotely connected with the affairs of the organization he heads—all these qualities will soon manifest themselves.



WILLIAM F. CANAVAN
President, I. A. T. S. E. & M. P. M. O. U.

This gentleman's formal title is William F. Canavan, President of the I. A. T. S. E. & M. P. M. O. U. but, fortunately for the labor movement at large, he is more commonly referred to simply as "Canavan of the I. A." For Canavan's prestige has not been gained solely through his efforts in the motion picture industry. A born leader of men, his personal qualifications, his wide knowledge of labor and of the men who contribute the labor, and his fine streak of humanism—these, coupled with his brilliant record as a mediator, are the qualities which he has contributed to his work on many labor battlefronts, in the interests of many labor crafts.

But he is best known within the motion picture industry for his splendid work as President of the International Alliance. A member of this organization's administrative family since 1913, when he was named Third International Vice-President, William F. Canavan had compiled an enviable record for the 13 preceding years as Business Representative of St. Louis (Mo.), Local Union 143.

Once numbered among the members of the I. A. official family, Canavan's advancement to his present position was rapid. In 1923, immediately following the unexpected retirement of President Charles C. Shay, Canavan, then First Vice-President, was installed as President, The next General Convention, in 1924, saw him elected to office in his own right.

From 1924 up to the present, Canavan has compiled a record of achievement in the interests of the organization which he heads that would be difficult to match. Upon taking over the direction of the Alliance in 1923, Canavan found himself head of a labor unit which required the utmost skill in leadership if it was to be preerved. With unflagging zeal and tireless body, the new leader turned to the work of organization with a vim and vigor which soon produced results—results which in the short span of a few years enabled the I. A. to gain its present prominent place among labor organizations, and which is characterized by eminent labor leaders as a model labor body.

With such energy did Canavan devote himself to his duties that convention time in 1928 found him completely worn out by his work. But he had only to announce his intention of retiring as President to stimulate a vast inpouring to his office of letters of protest against his decision coupled with pleas that he remain to guide the organization for another few years. While assenting reluctantly to these demands, Canavan has displayed no less enthusiasm for his work

(*Continued on next page*)

I. A. Embarks Upon Its 38th Year

THE approach of the 30th biennial Convention of the International Alliance brings to mind the rapid rise to power and prestige of this important section of organized American labor. It is estimated that more than a thousand delegates will gather in Los Angeles on June 2nd to pass on the work of the Alliance of the past two years and to decide on the policies and personalities for the next two years. It seems but a short time ago when only sixteen delegates gathered in the first Convention to vote for a President. It seems but a short time ago that William F. Canavan became such a brilliant I. A. executive. Yet the first meeting was held in 1893; and President Canavan has been holding important offices in the I. A. for fifteen years.

It is a fascinating job to review the work and the changing faces during these years and we undertake it here in our humble fashion for the benefit of the thousands of new members who only recently were listed in the I. A. rolls.

Formed in 1893

The organization known today as the International Alliance of Theatrical Stage Employees and Motion Picture Machine Operators had its inception in July, 1893, and was then known simply as the National Alliance of Theatrical Stage Employees. The Operators played a very small role in the proceedings because the motion picture industry was then still very young and small, and this now very powerful group was then feeble and hardly worth noticing. Projection equipment was of the crudest type, and early projectionists had nothing on which to try their mettle.

Only 9 Votes for President

The convention met in Elks Hall in New York. John G. Williams was elected President with nine votes. Sixteen votes were cast altogether. Some idea of the amount of business transacted at this Convention may be gleaned from the fact that in the book of the Combined Proceedings of all Conventions, this first Convention takes up a page and a half. The report of the 1928 Convention in Detroit takes up more than fifty pages.

The second national gathering took place in Crystal Hall, Chicago, in 1894. For several years the conventions were held annually. Lee M. Hart stepped up to the Presidency from the Treasuryship. The usual business was transacted, but at this Convention the real organization began to take shape. Basic resolutions were adopted, by-laws and amendments to the Constitution were accepted, and when the delegates broke up to go home the Alliance had become definite in shape and purpose. Although changing conditions since have forced many modifications and amplifications of policy and action, the International as it is today still retains the basic features of those early years.

32 Locals in 1895

Chandler Hall, Boston, 1895, was the scene of the third gathering. Claude L. Hagen, of New York, became the President. Thirty-one delegates were present. There were 32 Locals then in the Alliance, numbered from 1 to 32. Twenty of these sent representatives to Boston.

At this Convention a Toronto delegate suggested that the name of the Alliance be changed from National to International so as to give Canadian Locals prestige in the organization. A motion was made but was decisively defeated, the delegates preferring the old name. This item bobbed up again in later conventions, but was not adopted until 1902.

Elks Hall, in Detroit, was the scene of the fourth annual Convention in 1896. P. Maloney of Boston was elected President at the end of the meeting. The Convention settled many vexing problems and fixed conditions and scales for different types and classes of work under its jurisdiction.

Buffalo was the scene of the 5th Annual Convention in 1897. The delegates met in Council Hall and selected Charles R. Norman of New York City as their next President. There were 55 delegates present representing 32 Locals, which had a total membership of 2,315. Compare that figure with the I. A. membership today.

The next year the Convention was held in Creighton Hall, Omaha. William Wiggins of St. Louis was elected President for the ensuing year. At this Convention it was decided that it was not necessary to be a citizen of the United States in order to occupy the President's chair, as the Alliance laws did not cover this point. It is not an important point, but it does reveal the thoroughness and the seriousness with which the Locals of that day approached the problem of founding a national organization that would become a permanent institution. We know how well they succeeded and how successfully the Alliance has been maintained at the top since. Forty-eight ballots were cast altogether for the election of officers. Four delegates did not vote. Wiggins was elected with 29 votes.

The 7th Convention was held in Richelieu Hall, Cincinnati. Wiggins was re-elected for another term. The work of building up the Alliance was carried on vigorously. It had the ups and downs that are associated with all such ventures. It cannot be said, for instance, that the Cincinnati Convention was able to look back upon the Alliance and give every officer from 1893 to 1899 a completely clean ticket. There were the usual jurisdictional disputes, struggles with Locals not altogether agreeable to the discipline exerted over them by the Alliance. But Convention by Convention, these were smoothed out and the Alliance gradually but surely forged ahead. More territories were being organized year by year; the number of Locals grew and with them the prestige and the power of the national body increased.

76 Locals in 1900

In 1900 the Convention assembled in the Brooklyn Athenaeum, Brooklyn. Joseph B. Fenton of Washington, D. C., was elected President. Thirty-seven Locals sent delegates. Thirty-nine did not.

In 1901 the Convention met in Malones Hall, Toledo, and elected Charles H. Bohn, President. More Locals were present than the year previous. Their numbers in that year ran consecutively from 1 to 87.

"International" Adopted

The Tenth Annual Convention met in Emerald Hall, Norfolk, Va. Bohn was re-elected for a second term. Strikes had occurred here and there in the Locals' fight for better conditions and the aid of the I. A. was now solicited generally, the Locals having recognized that its aid was useful and necessary.

It was here that the name of the

Greetings to the Chief

(*Continued from preceding page*)

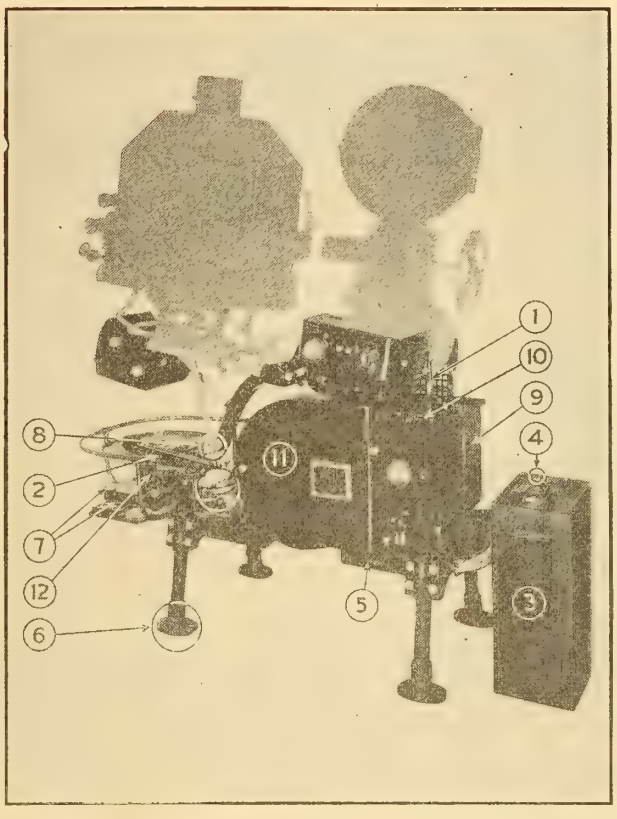
during his past two years of office.

A significant feature regarding Canavan's success in his office is the fact that employers hold him in no less respect and esteem than do the rank and file of men for whom he is constantly fighting. This is at once a tribute to his courage, his honesty and his fairness, and it has become an axiom of the show world that there are no "Canavan tactics," no "I. A. tricks." Those loudest in their praise of the I. A. leader are those with whom he is constantly negotiating for better conditions for his men. Commendation, then, beyond this point would be superfluous.

Greetings, then, to the chief . . . to the one man who more than anyone else is responsible for the eminence of the International Alliance in labor circles, for its reputation for honesty and fair dealing, and for the well-being of its thousands of members. Greetings, then, to a great leader, a great humanist—greetings to a gentleman, to a man's man.

J. J. F.

12 important features... *of the* Western Electric *Reproducer Set*



THE Western Electric reproducer set is built to weather the shocks and jars of many years of constant use. It stands four square on one base—no auxiliary pedestal to jar out of line. It combines highest quality sound reproduction with projection room requirements of durability, dependability and ease of operation.

These 12 points explain the world-wide popularity of the Western Electric reproducer set with exhibitors and projectionists:

1. All mechanical drives, no belts.
2. Highest quality reproducer, scientifically balanced to provide proper tracking.
3. Motor control box, exclusive Western Electric feature, guarantees uniform speed, eliminates changes in pitch.
4. Switch enables change from constant to variable speed when silents are shown.
5. Special foot brake and switch for quick stopping of machine.
6. Machine rests on ball joints, insures good mounting.
7. Rubber cushions eliminate shocks and jars from turntable.
8. Permits easy adjustment of machine to all projection angles.
9. Photo-electric cell amplifier, rubber cushioned and suspended on springs to eliminate noises caused by jars and vibrations.
10. Film-disc transfer switch enables projectionist to prepare machine for film or disc at time of threading rather than at moment of changeover.
11. Specially designed lower magazine, including a scientifically adjusted hold-back sprocket, eliminates "flutter" often caused by uneven film pull.
12. Scientifically designed mechanical filter system in turntable drive eliminates all noise due to action of gears.

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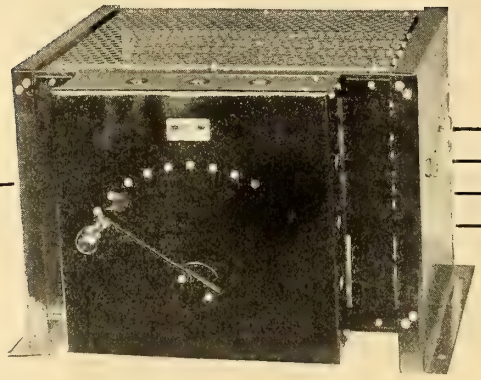
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GREETINGS to the I. A. T. S. E. & M. P. M. O. U. 30th Convention at Los Angeles, Calif.



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Alliance was finally changed from National to International.

With the Conventions held each year, they succeeded each other rapidly, the scene changing from city to city. In 1903 the Convention was held in Schenk's Hall, Columbus. P. T. Barry, of Boston, was elected president for the following year. In 1904 it was held in Academy Theatre Hall in Milwaukee, and P. T. Barry was re-elected for another term. In 1905 the Convention was held in the Duquesne Garden Amphitheatre in Pittsburgh, and the chief executive's job went to John Suarez of St. Louis. In 1906 it was held in Boston again in Berkeley Hall. Suarez was re-elected. In 1907 the Convention was held in Armory and Eagle's Hall in Norfolk, Va. Again Suarez was re-elected.

Organization Endangered

In 1908 the Convention was held in Minneapolis, John J. Barry of Boston became President. In 1909 it was held in Springfield, Ohio, and John J. Barry was re-elected. In 1910 it was held in Washington, D. C. Barry was again re-elected. In 1911 it was held in Niagara Falls. Charles C. Shay was elected President. This was the nineteenth Convention.

Shay was re-elected the following year (1912) in Peoria, Illinois, and re-elected for the third time in Seattle, in 1913. At this Convention it was decided to have the term of officers two years instead of one and to hold the Conventions every two years instead of annually.

Canavan's First Office

It was at the Seattle Convention in 1913 that William F. Canavan made his first appearance in the I. A. administrative family as Third International Vice-President. With Shay and the other officials he held office until 1915 when the Convention assembled in Chicago. Shay was once more re-elected President and Canavan was re-elected to the Third Vice-Presidency.

At the 1913 Seattle Convention, the Operators came officially into general recognition and hereafter the title of the International became International Alliance of Theatrical Stage Employees and Moving Picture Machine Operators of the United States and Canada. In 1917 the Convention assembled in Cleveland. Again Shay was re-elected for another two-year term, and Canavan moved up to the second vice-presidency.

I. A. Gains Prestige

In looking over the report of the combined Convention proceedings one notes at once how numerous and varied the problems of the International had become by this time. Hundreds of Delegates were now in attendance at each convention and the problems of individuals and of Locals were thrashed out in committee rooms and on the floor. The I. A. by this time was considered as one of the important sections of the American Federation of Labor and it enjoyed great prestige in the national labor movement because of the splendid way it had organized its craft.

In Ottawa, Canada, in 1919, the delegates re-elected Shay, president, for another two-year term. Canavan moved up to the First Vice-Presidency. James Lemke became manager of the Organizing and Claim Department. At this Convetion it was determined to hold the Conventions again annually instead of biennially. This was deemed necessary because of the tremendous amount of new business demanding attention every year.

So in 1920, the following year, we see Delegates again assembled in Convention in Cleveland. The International now had a total of 437 Local Unions and these had sent 557 delegates.

James Lemke was elected President for the following two years. Canavan remained in the First Vice-Presidency. It will be remembered that in 1919 Shay was re-elected for two years. When the delegates met again in 1920 Shay resigned, pleading ill health. Lemke was then elected to serve a two-year term as President, from 1920 to 1922.

The next Convention was held in 1922 in Cincinnati. Shay was once more chosen President for another two-year term that is, until 1924. Canavan remained as First Vice-President. At the 1920 Convention Shay had been made President Emeritus and had been presented with a gift of $10,000. The delegates cheered for five minutes when the presentation was made. "There were calls of 'Charlie Shay' from all over the hall," says the Convention Report. "Someone called for three cheers and they were given with a will."

Let us recall here that Charles Shay held the post of President for 10 years, from 1912 to 1920, and from 1922 to 1923.

Canavan Named President

Thursday, May 22, 1924, was a red letter day for the International Alliance. On that day, again in Cincinnati, the International elected William F. Canavan President. His administration, unbroken since that time, has made the International more powerful, wealthier, and its international membership happier than ever before.

Now, Canavan had already held the post as President in the interval between the time Shay suddenly relinquished his duties in the middle of his term, up to Convention time in 1924. As is well known, Canavan was elected President for his first full term of two years at this 1924 Convention.

The twenty-eighth Convention was held in 1926 at Cleveland. Canavan was re-elected until 1928. Five hundred and eighty Local Unions sent more than 700 delegates to this meeting.

The 29th Convention in 1928 was held in Moose Temple, Detroit. Preceding this meeting President Canavan had announced his intention of resigning his office; but when the delegates had gathered in Detroit, pressure was brought to bear on Canavan, and he finally consented to again accept his position. It was at this Convention that definite rules and regulations covering sound picture installation and reproduction work were promulgated.

Tribute to West Coast

At the 30th Convention which meets at the Hotel Alexandria in Los Angeles on June 2nd there undoubtedly will be a further codification of rules on the question of sound pictures. The non-theatrical field is sure to receive the close attention of the delegates, and practices which have been encouraged in some quarters within the past year are certain to be officially banned. Canavan will again be elected President of the Alliance, it is expected, as will those members of the present official family. Dignam's resignation as Assistant President will leave one vacancy to be filled.

This forthcoming meeting will mark the first time in 17 years that the International Alliance has convened on the West Coast, and Local Unions in that section of California are making elaborate preparations to play host to the delegates in return for what they regard as a graceful compliment to them.

The business sessions at this Convention are sure to attract the keen interest of the entire motion picture business, in view of the importance of the various subjects which will come up for action. A full report of the Convention will be presented in the next issue of this publication.

Projection Work Gratis For S. M. P. E.

Members of Washington, D. C., Local Union 224, contributed their services gratis to the recent S. M. P. E. meetings held recently in that city. Arrangements for projectionists were made by Tom Reed, B.A. of 224. This contribution to the engineers' meetings is in line with the regular policy of Local Unions when the Society meets in their cities.

Dignam Resigns I.A. Post

Harry Dignam has resigned his post as assistant to President William F. Canavan of the International Alliance. Dignam has just been named business representative of New York Local No. 1 of stagehands. No successor to Dignam at the I. A. office has yet been named.

Projection Room Safety Code

Promulgated by Pennsylvania State Department of Labor and Industry

THE following theatre regulations have been promulgated by the Pennsylvania State Department of Labor and Industry. The section dealing with motion picture projection rooms has been carefully abstracted and is presented herewith, with the assistance of the Department. This code has been arrived at only after the most intensive investigation and research by the Department, and it goes without saying that every article in the code is untainted by any guesswork and is based upon the facts as gathered from years of experience. This code holds unusual interest for the projectionist, and we hereby extend to the Pennsylvania State Department of Labor and Industry our thanks for making possible its publication.—THE EDITOR.

A. Motion picture projection rooms in theatres shall be constructed entirely of fire-resistive materials, such as brick, tile, concrete, two-inch gypsum or cement plaster on metal lath and metal frame or such other type of construction as may be approved from time to time.

B. When one (1) or more walls of the projection room abut on courts, streets or alleys, or are part of the outside walls of the building, it is permissible to place in one of the walls a window constructed of steel sash and wire glass, provided there is no building or part of a building within fifteen (15), feet of such window.

C. The minimum size of a projection room containing only one projector not equipped for sound pictures shall be six (6) feet wide, nine (9) feet deep, and seven and one-half (7½) feet high. For each additional projector, spotlight, or stereopticon, the width shall be increased by three and one-half (3½) feet per machine. Where sound picture equipment is installed in the projection room, the depth of said room shall be such as to provide a clear space of three and one-half (3½) feet, at the rear of the projector, the height shall be not less than eight (8) feet, and there shall be provided a clear working space between each projector and between the projector and the wall on the operating side of not less than three and one-half (3½) feet.

Special Sound Requirements

D. Where sound picture equipment is used, the batteries shall be located in a separate compartment or room, preferably on the same floor as the projection room, and shall be adequately ventilated. The minimum height of the fader or volume control shall not exceed five (5) feet and shall be so placed that the projectionist can operate it without leaving his position at the observation ports. The sound panel board or amplifier rack shall be so placed as to be visible to the projectionist from the usual operating position.

E. The projection room shall be easy of access and shall not open directly into the auditorium or balcony, unless a vestibule with fire-resistive doors leading from the vestibule is provided. There shall be at least two means of egress from every projection room containing more than one (1) projector. Access to the projection room by trap doors is prohibited. The projection room doors shall open out and be equipped with automatic closing devices or be arranged to be normally held shut by gravity.

F. All wires in the projection room shall be in conduit, and the conduit system shall be thoroughly grounded. Each projector lamp house, mechanism and frame shall be permanently grounded. A remote control switch shall be provided in the projection room to enable the projectionist to light the auditorium instantly.

Ventilating System

G. In every projection room there shall be installed a ventilating system for the removal of fire and smoke. This system shall be capable of producing a complete change of air every two (2) minutes.

The system shall consist of a main vent pipe constructed of incombustible material, without soldered joints, and at least sixteen (16) inches in diameter. The vent pipe shall be insulated from any inflammable substance or parts of the building for its entire length. Such vent pipe shall lead directly to the outside air, or to a special incombustible vent flue. The exhaust draft in this vent shall be produced by mechanical means, such as a motor driven fan or a high velocity fan used as an ejector, or a combination of both systems; or by natural ventilation where conditions are such as to produce the required change of air and when approved by the Department. In no case shall the motor be installed in the main vent pipe.

The fresh air supply shall be provided by gravity from the roof or outside wall through ducts or openings of such area that the velocity shall not exceed two hundred (200), feet per minute when the exhaust fan is in operation. The openings shall be located so as to provide a uniform distribution of the air supply throughout the projection room. The fresh air supply may also be secured through intake openings connected direct to the auditorium, except where sound picture equipment is used, and in which case, the air supply shall be provided from the outside of the building.

These openings shall be of such quantity and size as to permit the entire ventilating system to produce the complete change of air in the projection room every two (2) minutes, with the velocity of the air not to exceed aforementioned limitations. The openings shall be covered with wire screens of one-quarter (¼) inch mesh and be located at a point not more than eighteen (18) inches above the floor.

If ventilating hoods over projectors are used, they shall be connected direct by metal ducts to the exhaust flue independent of the main vent pipe from the projection room.

The motors of the exhaust system shall be connected to the electric circuit controlling the exit lights and the emergency lighting system, provided the emergency voltage remains constant when in use. Where the voltage of the emergency circuit is not constant, the motors of the exhaust system shall be placed on an independent circuit. The switch controlling the exhaust system shall be manually operated, placed either within or directly outside the projection room, and in addition, an auxiliary switch shall be placed in the port shutter fuse system so arranged as to operate automatically to start the motor whenever a fire occurs which would cause the ports to close.

Number of Ports

H. There shall be not more than two ports per projector or stereopticon, one for the projectionist and one for the projector.

I. Every port shall be equipped with vertical rising or other approved type of shutter operating in guides and so arranged that when released it will fall by gravity and completely close and practically seal the port. The bottom stops shall be padded with incombustible material so as to reduce the sound of impact as much as possible when the shutter falls.

The shutters shall be held open by means of cords connected together with a master cord equipped with fusible links which are located at the various points where fires are likely to occur. This system of cords shall be installed and shall operate in accordance with an approved standard or other equally effective systems may be installed. (Refer to Plate 1.)

J. There may be located in the projection room one shelf constructed of

fire-resistive material. If clothing is to be stored in the projection room it shall be placed in metal lockers.

Film Cases

A separate fireproof self-closing metal case or multiple case with individual compartments with separate lids made without solder, shall be provided for each individual film and such film cases shall be tightly closed at all times. Each film shall be kept in one of such cases or compartments at all times when the same is not in the magazine of the projector or in the process of rewinding.

All rheostats shall be mounted on and securely fastened to slate insulators located as near as practical to the ceiling of the projection room. Rheostats may be placed outside of the projection room provided they are mounted on slate insulators or other equivalent heat and dielectric insulator and are properly enclosed.

Fire Extinguishers

Every projection room shall be provided with not less than two (2) approved fire extinguishers of not less than one (1) quart size and located immediately inside each door. There shall also be provided one twelve quart bucket of sand for each projector.

A metal can with self-closing cover shall be provided as a receptacle for waste material. Hot carbons shall be thrown into a separate metal container provided for that purpose. The projection room shall be kept free from loose ends or strips of film, paper, oils, rags, and all other rubbish. Smoking or striking matches or using open lights in projection room is absolutely prohibited.

Each projection room shall be equipped with an approved type of enclosed film rewinder, or a separate fire-resistive rewinder room shall be provided.

K. Means shall be provided to enable the projectionists to signal the management when necessary. Such signal shall consist of a telephone, bell or buzzer and shall be located where it will be heard in the manager's office or by the ticket seller or ticket receiver.

Fire Shutters

L. All projectors, stereopticons and spot lights shall be securely fastened to the floor. Projectors shall be provided with automatic fire shutters or aprons and all such projectors that are so constructed that the eyes of the projectionist are exposed to the flare of the crater image or "spot" shall be provided with an approved eye shield. Six months after date of promulgation of these regulations every motion picture projector shall be equipped with an approved device, which in case of accidental interference with the proper operation of the projector, will function automatically and instantly to cut off the light and stop the projector before fire has occurred, or will automatically cut off the projector light, stop the projector and prevent the travel of fire beyond the entrance of either magazine.

M. Toilet and wash facilities shall be provided for projectionists except where a licensed assistant or relief projectionist is available at all times for relief purposes and where a signal system is installed as required by paragraph (J), of this rule.

Personal Conveniences.

The location of such toilet and wash facilities shall be within the walls of the projection room proper or in an approved fire resistive compartment or room directly connected to the projection room.

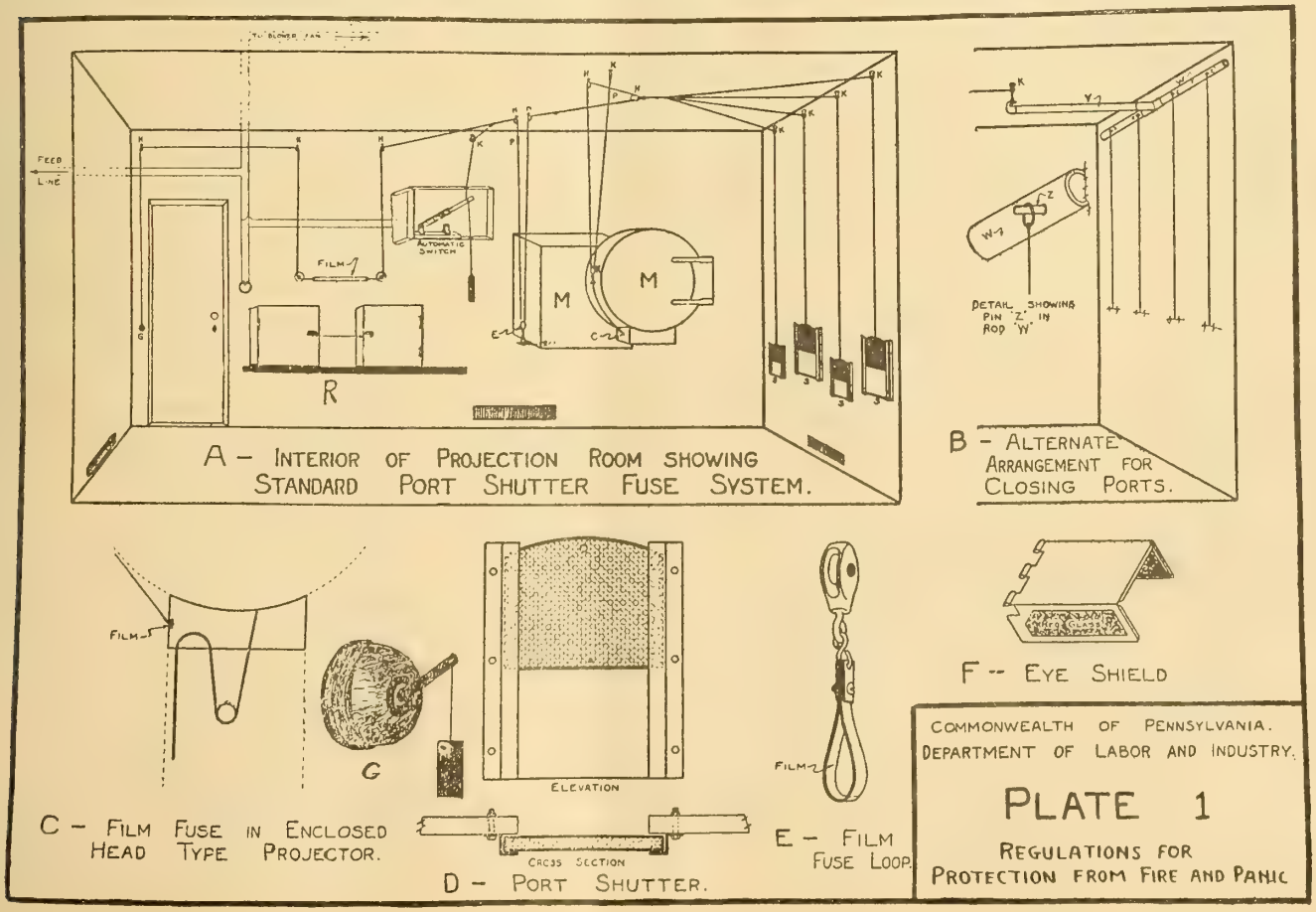
When sewer facilities are not available, chemical toilets may be provided, if installed according to the regulations of the Department of Industrial Sanitation.

N. Motor generator sets or mercury arc rectifiers shall not be placed in the projection room.

New Rust Remover

Lubricant for removing rust has been prepared by Blue Seal Product Co., of Brooklyn, which claims that its use will lengthen the life of lamps. This lubricant, the company states, is especially made for arc lamps. It has heat-resisting properties that insure against odor or smoke and one application at a time is all that is required for a great period of time, Blue Seal declares.

This same lubricant has been tested and found to be a rust remover and preventive both for lamp houses and magazines, the company says.



Some Sources of Artificial Light

By Engineering Dept., Westinghouse Lamp Co.

IT may be said that the history of artificial illumination began with the discovery of fire because, by picking up one of the burning embers, man learned the use of the torch—really a portable lamp which he later constructed of such materials as fagots or knots of resinous wood. Natural fats and wax replaced the wood of the torch, until, with the discovery and development of the wick, the use of oils for fuel was possible. Solidified oils and fats in combination with the wick formed the more convenient candle. Whale oil and similar organic fuels were not generally superseded by mineral oil (petroleum), before the middle of the nineteenth century.

The first marked scientific improvement came during the latter part of the nineteenth century when a chimney was added to the oil lamp. The draft thus afforded resulted in more complete combustion of the fuel and produced a cleaner, more brilliant flame.

In the earlier gas and oil lamps, the light was emitted by solid incandescent particles of carbon in the flame itself. If these particles passed out of the flame without being consumed, the flame smoked and the particles formed lampblack. However, when gas is first mixed with air so that plenty of oxygen is available, the carbon particles are entirely consumed and furnish additional heat. The flame is then practically invisible. Such flames were used for a later development of lighting where solid substances such as lime were heated to incandescence. This produced a brilliant white light of a quality desirable for theatrical purposes and was so used for a number of years. The common expression, "in the limelight," arose from this form of illumination.

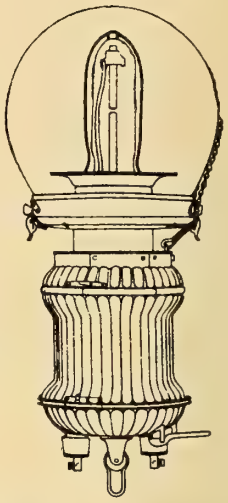
The greatest step in the development of gas lighting was the invention of the Welsbach mantle in 1886. These mantles were made from a knitted fabric of cotton or artificial fibre, saturated with a solution of certain salts and oxides of thorium and cerium. When first ignited, the organic material of the mantle burned away, leaving the ash in the original form of the fabric. When heated the mantle became highly luminous and produced a much whiter, more efficient source of light than the open flame gas burner. The Welsbach mantle is still in general usage where gas is the only source of illumination.

The Electric Arc Lamp

Sir Humphrey Davy in 1809 demonstrated the first electrical arc which he had discovered while experimenting with a battery of 2,000 cells. About ten years before, Alesandro Volta, an Italian professor (after whom our electrical term "volt" is named), discovered a chemical method of obtaining electricity, the forerunner of our modern dry batteries. Davy, working with the battery which he had constructed after Volta, found that by connecting the terminals to two pieces of charcoal, touching them together and pulling them apart again, he could produce an intense white light. Not only did the charcoal terminals become luminous but also the crescent-shaped stream of gas connecting them. From this latter action the term "arc" is derived.

To operate an arc lamp, the electrodes, across which the arc is maintained, must first be brought together to allow the current to start to flow and then be separated so as to draw

Arc lamp



the arc. The carbon points become extremely hot when sufficient current flows across the gap, the positive electrode reaching a temperature of from 3,000 to 3,500 degrees Centigrade (approximately 5,400 to 6,300 degrees Fahrenheit). At this temperature the carbon evaporates and the electrodes are slowly consumed. If they are not moved constantly toward each other, the arc becomes longer and longer until the current is finally broken.

To make a practical arc lamp it was, therefore, necessary to devise a mechanism which would—

(1) Bring the carbon points together when no current was flowing in the circuit.

(2) Separate them automatically immediately after the current began to flow.

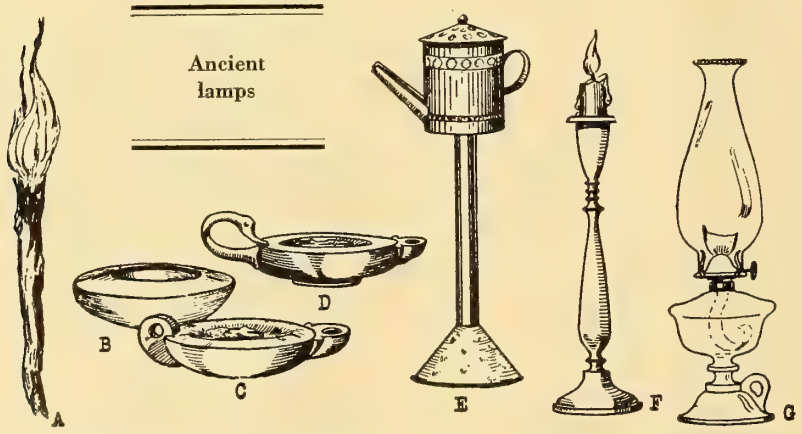
(3) Feed the carbons as fast as they were consumed so that the points would not become too widely separated.

(4) Short-circuit any lamp whose carbons were entirely consumed or which for any reason failed to operate. This last feature was necessary since most arc lamps were operated on series circuits where current flowed from one to the other and where the failure of any one lamp would otherwise have extinguished the entire series.

Multiple Type Arcs

Many arc lamps of the multiple type were and still are used for projection purposes, chiefly in motion picture theatres and in searchlights. On multiple circuits it is necessary to provide not only regulating mechanisms for the carbons but a ballast resistance or reactance to limit and steady the flow of current. The ballast may consume as much as one-third to one-half the power consumed by the arc itself and hence

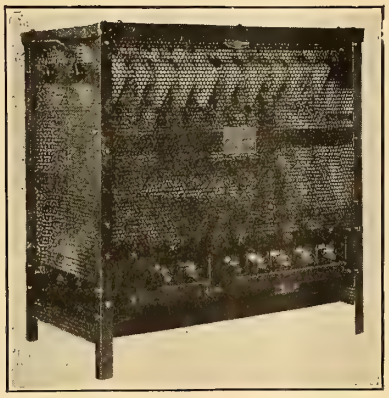
Ancient lamps



A—Torch; B—Stone lamp (3000 B.C.); C—Pottery lamp (200 A.D.); D—Bronze lamp (1000 A.D.); E—Flemish oil lamp (1600); F—Candle (1800); G—Kerosene oil lamp (1870).

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SUBURBS.

ACTON, The Crown Cinema
ACTON, The Globe Cinema
ACTON, Messrs. Gelehrowe Sound Equipt.
BALHAM, The Hippodrome.
BALHAM, The Palladium
BATTERSEA, The Super Palace.
BERMONDSEY, The Colleen Cinema.
BERMONDSEY, The Palace
BERMONDSEY, The Cinema
BETHNAL GREEN, The Foresters Cinema.
BETHNAL GREEN, The Palace.
BOW, The Palace
BRIXTON, The Astoria
BRIXTON, The Palladium.
BRIXTON, The Pavilion
BRIXTON, The New Royalty.
CAMBERWELL, The Empire.
CAMBERWELL, The Grand.
CAMDEN TOWN, The Hippodrome.
CANNING TOWN, The Imperial.
CANNING TOWN, The Super.
CATFORD, The Queens Hall
CHELSEA, The Picture House.
CHISWICK, The Royal
CHISWICK, The Electric
CHISWICK, The Colosseum.
CLAPHAM, The Imperial
CLAPHAM, The Majestic
CLAPHAM, The Pavilion
CLAPTON, The Rink Cinema.
CLAPTON, The Kenning Hall
COMMERCIAL ROAD, The Popular.
CRICKLEWOOD, The Queens Hall.
CROUCH END, The Perfect Picture House.
DALSTON, The Amhurst Hall.
EALING, The Kingsna
EALING, The Walpole Cinema.
EAST HAM, The Boleyn Cinema
EDMONTON, The Hippodrome.
FINCHLEY, The Coliseum.
FINCHLEY, The Frognal Cinema.

SUBURBS (cont.).

FINCHLEY, The New Bohemia
FINSBURY PARK, The Astoria
FINSBURY PARK, The Rink Cinema
FOREST GATE, The Forest Lane Cinema.
FOREST GATE, The Queens Cinema.
GOLDERS GREEN, The Lido
GREENWICH, The Trafalgar Cinema
HACKNEY, The Empire
HACKNEY, The Empress
HAMMERSMITH, The Blue Halls
HAMMERSMITH, The Broadway
HARLESDEN, The Coliseum.
HARROW ROAD, The Coliseum
HARROW ROAD, The Prince of Wales
HIGHBURY, The Picture Palace
HOLLOWAY, The Grand
HOLLOWAY, The Scandinavian Picture House
HOWARTON, The Castle Cinema
HOXTON, The Cinema
ILFORD, The Super
ISLEWORTH, The Walton Studios.
ISLINGTON, The Blue Hall
ISLINGTON, Collins Music Hall
ISLINGTON, Gainsborough Studios.
ISLINGTON, The Lido
KENNINGTON, The Princes
KENSINGTON, Bolton Cinema
KENSINGTON, The Bijou
KENSINGTON, The Super
KENTISH TOWN, The Palace.
KILBURN, The Palace
KING'S CROSS, The Scala.
LEE GREEN, The Savoy Cinema.
LEWISHAM, The Hippodrome
LEWISHAM, The Kings Hall
LEWISHAM, The Prince of Wales.
LEYTON, The Picture House
MANOR PARK, The Coliseum
MANOR PARK, The Gaumont.
MERTON, The Abbey Cinema
NEW CROSS, The New Cross Kinema.
NEW CROSS, The Broadway Theatre.
NEW NORTH ROAD, The Victoria
NORWOOD, The Albany.
NORWOOD, The Regal
NORWOOD, The Rialto
NOTTING HILL, The Coronet.
NOTTING HILL, The Imperial.
OLD KENT ROAD, The Astoria.
PADDINGTON, The Grand.
PALMERS GREEN, The Queens Hall.
PECKHAM, The Imperial.
PECKHAM, The Picture.
PLUMSTEAD, The Kinema.
POPLAR, The Grand
PUTNEY, The Palace.
ROTHERHITHE, The Hippodrome.
RUSHEY GREEN, The Queens Hall
SHEPHERD'S BUSH, The Park Cinema.
SHEPHERD'S BUSH, The Silver Cinema.
SHOREDITCH, The Olympia
SOUTHFIELDS, The Lyceum.
SOUTHWARK, The Palace
STAMFORD HILL, The Regent
STAMFORD HILL, Stamford Hill Cinema
STEPNEY, The Majestic
STOCKWELL, The Palladium.
STOKE NEWINGTON, The Albion
STOKE NEWINGTON, The Majestic.
STRATFORD, The Broadway Cinema.
STRATHAM, The Astoria.
STREATHAM, The Golden Domes.
STREATHAM, The Empire.
STREATHAM, The Streatham Hill Cinema
TOOTING, The Regent.
TOOTING, The Pavilion.
TOTTENHAM, The Bruce Grove Cinema.
TOTTENHAM, The Palace
UPTON PARK, The Carlton.
WALHAM GREEN, The Red Hall.
WALTHAMSTOW, The Carlton.
WALTHAMSTOW, The Crown.
WALTHAMSTOW, The Pavilion.
WALTHAMSTOW, The Super.
WALTHAMSTOW, The Victoria.
WANDSWORTH, The Palace
WATERLOO, Canterbury Music Hall.
WHITECHAPEL, The Royal
WOOLWICH, The Hippodrome.

ENGLAND

BEDFORDSHIRE.

LUTON, The Alma.
LUTON, The Cinema.
LUTON, The Empire.
LUTON, The Palace
LUTON, The Wellington Cinema.

BERKSHIRE.

MAIDENHEAD, The Plaza
READING, The Central.
READING, The Pavilion

BUCKINGHAMSHIRE.

AYLESBURY, The Market Cinema.
AYLESBURY, The Pavilion
BEACONSFIELD, British Lion Film Studios.
HIGH WYCOMBE, The Grand Cinema.
HIGH WYCOMBE, The Majestic
HIGH WYCOMBE, The Palace

CAMBRIDGESHIRE.

CAMBRIDGE, The Victoria Cinema.
WISBECH, The Hippodrome.

CHESHIRE.

BIRKENHEAD, The Argyle Cinema.
BIRKENHEAD, The Coliseum.
BIRKENHEAD, The Pavilion
BIRKENHEAD, The Scala
CHESTER, The Music Hall.
CREWE, The Empire
CREWE, The Palace.
HEBDEN, The Lyceum
MACCLESFIELD, The Premier
SANDBACH, The Town Hall
STOCKPORT, The Alexandra Cinema.
STOCKPORT, The Don Cinema
STOCKPORT, The Palladium
STOCKPORT, The Wellington Picture House.
TRAMERE, The Coliseum
WALLASEY, The Capitol
WINSFORD, The Magnet Cinema

CORNWALL.

FALMOUTH St Georges Hall
HAYLE, The Copperhouse Cinema.

CUMBERLAND.

CARLISLE, The Picture House.
WHITEHAVEN, The Empire.

DENBIGHSHIRE.

WREXHAM, The Glynn Cinema.

DERBYSHIRE.

BEIGHTON, The Central Hall.
DERBY, The Empire
DERBY, The Gaumont Picture House.
DERBY, The White Hall Cinema
GLOSSOP, The Empire

DEVONSHIRE.

DEVONPORT, The Alhambra
DEVONPORT, The Electric Cinema.
EXETER, The Kings Hall
EXETER, The Palladium.
PLYMOUTH, The Cinedrome
PLYMOUTH, The Gaiety
PLYMOUTH, The Hippodrome.
PLYMOUTH, The Palladium.
SIDMOUTH, The Grand.
TORQUAY, The Picture House.

DORSET.

WEYMOUTH, The Palladium
WOOLSTON, The Picture Theatre.

DURHAM.

BENWELL, The Grand Cinema
BILLINGHAM ON TEES, The Picture House.
BLAYDON ON TYNE, The Pavilion
CHESTER LE STREET, The Cinema.
CONSETT, The Empire.
CONNETT, The Plaza
CROOK, The Hippodrome.
DARLINGTON, The Alhambra.
DARLINGTON, The Empire
DUNSTON ON TYNE, The Imperial
DURHAM, The Chester Cinema.
DURHAM, The Kinema

ENGLAND

DARTFORD, The Scala
DEAL, The White Royal.
DOVER, The Plaza
FOLKESTONE, The Central
FOLKESTONE, The Leas Cliff
GILLINGHAM, The Grand
GRAVESEND, The London Cinema.
GRAVESEND, The Plaza
GREENWICH, The Trafalgar Cinema.
MARGATE, The Cotton Cinema.
MARGATE, The Hippodrome
MARGATE, The Jetty
MARGATE, The Lounge
RAMSGATE, The Royal Hall
RAMSGATE, The Pavilion
RAMSGATE, The Queens
SANDWICH, The Empire
SHEERNESS, The Hippodrome
SIDUP, The Kings Hall
TUNBRIDGE, The Capitol
TUNBRIDGE WELLS, The Gt. Hall Cinema.
TUNBRIDGE WELLS, The Kosmos Kinema.
TUNBRIDGE WELLS, The Opera House

LANCS.

ACCRINGTON, The Princes
ARDWICK, The Picture House
BLACKPOOL, The King Edward Cinema.
BLACKPOOL, The Princess Cinema.
BLACKPOOL, The Tivoli Cinema.
BLACKPOOL, The Waterloo
BERWICK, The New Royal
BOLTON, The Queens Hall
BOOTLE, The Broadway
BOOTLE, The Imperial
BURNLEY, The Colosseum.
BURY, The Scala
CARNTOUTH, The Kinema Theatre.
CHORLTON, The Savoy
GARSTON, The Empire
GORTON, The Palladium
GRANGE OVER SANDS, The Victoria.
LANCASTER, The Palladium.
LEIGH, The Palace
LIVERPOOL, The Clubmoor Cinema.
LIVERPOOL, The Empire
LIVERPOOL, The Hippodrome
LIVERPOOL, The Park Palace.
LIVERPOOL, The Plaza
LIVERPOOL, The Premier Picturedrome.
LIVERPOOL, The Prince of Wales
LIVERPOOL, The Rivoli
LIVERPOOL, The Scala
LIVERPOOL, The Theatredero.
MANCHESTER, The Casino.
MANCHESTER, The Cinema Picture House.
MANCHESTER, The Gaiety
MANCHESTER, The New Adelphi.
MANCHESTER, The Royal Hall.
MANCHESTER, The Oxford Picture House
MANCHESTER, The Palace
MANCHESTER, The Picture House.
MANCHESTER, The Theatre Royal
MILES PLATTING, The Hippodrome
MILNROW, The Empire
NEW BERRY, The Lyceum
OLDHAM, The Palladium
OPENSHAW, The Royal
PENDLETON, The Empress
PENDLEBURY, The Palace
PRESTON, The Star
PRESTON, The Victory
RAWTENSTALL, The Picture House.
ROCHDALE, The Empire
SEAFORTH, The Stella
ST HELENS, The Hippodrome
SWINTON, The Adelphi
TYLDESLEY, The Carlton
TYLDESLEY, The Royal
URMISTON, The Empire
WARRINGTON, The Empire
WIGAN, The Princes

LINCOLNSHIRE.

BARTON-ON-HUMBER, The Oxford
CLEETHORPES, The Empire
GRIMSBY, The Premier Picture Palace
GRIMSBY, The Scenic
LINCOLN, The Kinema
SLEAFORD, The Corn Exchange Cinema
STAMFORD, The Central Cinema

ENGLAND

DURHAM, The Palace
DURHAM, The Pavilion
ELDON LANE, The Club Cinema
ESH WINNING, The Pavilion
GATESHEAD, The Bensham Picture House.
GATESHEAD, Ravensworth Hall
GATESHEAD, Shipcote Hall
GRANGE VILLA, The Pavilion
HOUGHTON LE SPRING, The Coliseum
MEADOW VILLA, The Co-op Cinema
SEAHAM HARBOUR, The Theatre Royal.
SHILDON, The Picture House
SOUTH SHIELDS, The Pavilion.
SOUTH SHIELDS, The Scala
SOUTH SHIELDS, The Queens
STOCKTON, The Cinema.
STOCKTON, The Empire
STOCKTON, The Grand
TRIMDON COLLIERY, The Imperial
WALKER, The Wetheck Cinema
WEST STANLEY, The Albert Hall
WEST STANLEY, The Pavilion
WINGATE, The Palace Theatre

ESSEX.

BECONTREE, The Regent Cinema
BRAINTREE, The Central
CHELMSFORD, The Pavilion
COLCHESTER, The Hippodrome
DAGENHAM, The Grange
EPPING, The Cinema
GRAYS, The Empire
HARRINGAY, The Coliseum
LEIGH ON SEA, The Coliseum
ROMFORD, The Lauer Cinema
SOUTHEND, Garons Cinema
SOUTHEND, The Strand Cinema
UPMINSTER, The Capitol

FLINT.

FLINT, The Palladium

GLOUCESTERSHIRE.

BRISTOL, The Gem Cinema
BRISTOL, The Kings Cinema
BRISTOL, The New Palace
CIRENCESTER, The Picture House
GLOUCESTER, The Theatre de Luxe
STROUD, The Picture House
TEWKESBURY, The Palace

HANTS.

ALDERSHOT, Manor Park Pavilion
ALDERSHOT, The Pavilion
ALDERSHOT, The Palace
ALTON, The Picture Theatre
ANDOVER, The New Theatre
ANDOVER, The Electric Picture Hall
BOURNEMOUTH, The Coronation
BOURNEMOUTH, The Electric
BOURNEMOUTH, The Picture House
PORTSMOUTH, The Arcade
PORTSMOUTH, The Regent
SOUTHAMPTON, The Alexandra
SOUTHAMPTON, The Picture House
SOUTHAMPTON, The Regent
SOUTHSEA, The Apollo
SOUTHSEA, The Plaza
VENTNOR, The Bijou Cinema
WINCHESTER, The Picture House

HEREFORDSHIRE.

HEREFORD, The Kemble Theatre

HERTS.

ELSTREE, The British & Dominion Studios
ELSTREE, The British International Studios.
ST ALBANS, The Grand Palace
ST ALBANS, The Picturedrome
WATFORD, The Central
WATFORD, The Plaza

HUNTINGDONSHIRE.

HUNTINGDON, The Broadway

KENT.

BEXLEY HEATH, The Palace
BIRCHINGTON, The Picture House
BROADSTAIRS, The Picture House.
CHATHAM, The Imperial Playhouse
CHATHAM, The Regent
DARTFORD, The Cinesia.

ENGLAND

MIDDLESEX.

BRENTWOOD, The Palace.
HARROW, The Coliseum
HARROW, The Embassy
HAYES, H.M.V. Studios.
SOUTHALL, The Gem Cinema
SOUTHALL, The Palace
STAINES, The Empire
STAINES, The Majestic
TWICKENHAM, The Luxor Cinema
TWICKENHAM, The Twickenham Film Studios.
WEMBLEY, British Talking Pictures
WEMBLEY, The Majestic
WINCHMORE HILL, The Capitol
YIEWSLEY, The Marlborough Cinema.

NORPOLK.

NORWICH, The Haymarket.

NORTHANTS.

KETTERING, The Electric
PETERBOROUGH, The Bijou Cinema.
PETERBOROUGH, The Broadway Cinema.
PETERBOROUGH, The City Picture House.

NORTHUMBERLAND.

ASHINGTON, The Miners Theatre
BERWICK ON TWEED, The Playhouse
BLYTH, The Central Cinema
BLYTH, The Theatre Royal
HEATON, The Electric
HEXHAM, The Queens Hall
MORPETH, The Coliseum
MORPETH, The Playhouse
NEWCASTLE, The Brighton Electric Theatre.
NEWCASTLE, Grangers Picture House.
NEWCASTLE, The Pavilion
NEWCASTLE, The Plaza
NEWCASTLE, The Savoy
NORTH SHIELDS, The Albion
NORTH SHIELDS, The Comedy
NORTH SHIELDS, The Princes
PRUDHOE, The Electric Theatre
WHITLEY BAY, The Colosseum

NOTTINGHAMSHIRE.

MANSFIELD, The Picture House.
MANSFIELD, The Empire
NEWARK, The Palace
NOTTINGHAM, The New Empress.
NOTTINGHAM, The Hippodrome
NOTTINGHAM, The Mechanics Hall.
NOTTINGHAM, The Picture House
NOTTINGHAM, The Scala

OXFORDSHIRE.

BANBURY, The Palace
OXFORD, The Super Cinema.

SHROPSHIRE.

SHREWSBURY, The Kings Hall.

SOMERSET.

BATH, The Assembly Rooms
BURNHAM, The Electric Cinema.
FROME, The Palace
HIGHBRIDGE, The Picture House.
TAUNTON, The Lyceum
WESTON SUPER MARE, The Central Cinema
YEOVIL, The Palace.

STAFFORDSHIRE.

BURSLEM, Coliseum.
CRADLEY HEATH, Royal.
DARLASTON, The Olympia.
DARLASTON, The Picturedrome.
LONGTON, Alexandra
LONGTON, Empire.
OLDBURY, The Grand
STAFFORD, The Sandonia.
STOKE ON TRENT, The Princes
TAMWORTH, The Grand Cinema
WALSALL, The Grosvenor Cinema
WEDNESBURY, The Picture House
WILLENHALL, The Picture House

SUFFOLK.

BECCLES, The Cinema.
HAVENHILL, The Empire.
IPSWICH, The Picture House
IPSWICH, The Regent

ENGLAND

SURREY

CATERHAM, The Capitol
CROYDON, The Picture House.
CROYDON, The Palladium
DORKING, The Pavilion
DORKING, The Playhouse.
EPSOM, The Capitol
EPSOM, The Royal
KINGSTON, The Super Cinema
LEATHERHEAD, The Picture House.
NEW MALDON, The Plaza.
NAYNES PARK, The Cinema.
REDHILL, The Picture House.
REIGATE, The Hippodrome
WALTON, The Capitol
WALTON, The Nettlefold Studios.
WALTON, The Regent.

SUSSEX.

BRIGHTON, The Academy Cinema.
BRIGHTON, The Court Cinema
BRIGHTON, The Duke of Yorks
BRIGHTON, The Palladium
CHICHESTER, The Exchange Cinema.
EASTBOURNE, The Central.
HAYWARDS HEATH, The Heath Theatre.
HORSHAM, The Capitol
HORSHAM, The Central.
LEWES, The Cinema
NEWHAVEN, The Kinema
SEAFORD, The Empire

WARWICK.

ALCESTER, The Picture House
BIRMINGHAM, The Acocks Green Picture Playhouse.
BIRMINGHAM, The Adelphi Cinema
BIRMINGHAM, The Alhambra
BIRMINGHAM, The Astoria
BIRMINGHAM, Aston Heath Picture House
BIRMINGHAM, Birchfield Picture House
BIRMINGHAM, The Broadway Cinema
BIRMINGHAM, The Carlton
BIRMINGHAM, The Coliseum Theatre
BIRMINGHAM, The Coronet
BIRMINGHAM, The Hippodrome
BIRMINGHAM, The Imperial
BIRMINGHAM, The Grand
BIRMINGHAM, Green Lane Picture House.
BIRMINGHAM, The Handsworth Cinema
BIRMINGHAM, The Imperial
BIRMINGHAM, The King's Norton Cinema
BIRMINGHAM, Lyric Picture Playhouse
BIRMINGHAM, The Moseley Picture House.
BIRMINGHAM, The Metropole
BIRMINGHAM, The New Imperial
BIRMINGHAM, The New Crown
BIRMINGHAM, The Pavilion Palace
BIRMINGHAM, Oscar Picture Theatre.
BIRMINGHAM, The Rex Cinema
BIRMINGHAM, The Palace Cinema
BIRMINGHAM, The Palladium
BIRMINGHAM, The Picturedrome
BIRMINGHAM, The Rink Picture House
BIRMINGHAM, The Rookery Picture House
BIRMINGHAM, The Scala
BIRMINGHAM, The Springfield Picture Playhouse
BIRMINGHAM, The Select Cinema
BIRMINGHAM, The Villa Cross Cinema
BIRMINGHAM, The Walford Picture Theatre
BIRMINGHAM, The Watson Green Cinema
BIRMINGHAM, Bordesley, The Electric
BIRMINGHAM, Dudley, The Palace
BIRMINGHAM, Erdington, The Cinema
BIRMINGHAM, Erdington, The Palace
BIRMINGHAM, Handsworth, The Grand

ABERDEEN, The Palace Theatre
ABERDEEN, The New Palace
ALLOA, The Town Hall
ARBROATH, Palace Theatre
AYR, The Playhouse
BATHGATE, The Regent
BELLSHILL, The Alhambra
BLACKBRIDGE, The Cinema
DOUNES, The Picture House
CLYDEBANK, The Bank Cinema
COATBRIDGE, The Picture House
COATBRIDGE, The Empire Theatre
CUMBERNAULD, The Cinema
DUMBARTON, The Picture House
DUMBARTON, The Rialto Cinema
DUNDEE, The Kinema Cinema
DUNDEE, The Regard Picture House
DUNDEE, The Palace Cinema

GLASGOW, Hampden Picture House.
GLASGOW, Hutchesons Hall
GLASGOW, Maryhill Picture House.
GLASGOW, New Kings Cinema
GLASGOW, New Savoy Theatre.
GLASGOW, Park Cinema
GLASGOW, Picture House.
GLASGOW, Playhouse.
GLASGOW, Plaza
GLASGOW, Premier Picture House
GLASGOW, Regal Cinema
GLASGOW, Regent Picture House
GLASGOW, Springburn Cinema
GLASGOW, Strathbyth Cinema
GLASGOW, Tollcross Cinema
GLASGOW, Tron Picture House
GLASGOW, Wellington Picture Palace.
GLASGOW, Western Cinema
GREENOCK, La Scala Cinema
GREENOCK, The Gaiety Cinema
GREENOCK, La Scala Cinema
HAMILTON, The Picture Palace
HAMILTON, La Scala Cinema
INVERNESS, The Empire Majestic.
IRVINE, The Empire.

ABERAMON, The Grand Cinema
ABERTILLERY, The Pavilion
BANGOR, The New City Picture House.
BARRY, The Theatre Royal
BRIDGEND, The Palace.
CARDIFF, The Capitol.
CARDIFF, The Coliseum.
CARDIFF, The Pavilion.
CWM, The Temple
LLANDUDNO, The Palladium

BELFAST, The Picture House.
CORK, The Palace
CORK, The Pavilion
CORK, The Ice Cinema
CORK, The Savoy
COUNTY DERRY, The Opera House.
DUBLIN, The Capitol
DUBLIN, The Coliseum.
DUBLIN, The Corlets
DUBLIN, The Hippodrome
DUBLIN, The Pavilion.

BELGIUM

BRUSSELS, The Coliseum.
BRUSSELS, La Scala.
GHENT, The Cinema

DENMARK.

COPENHAGEN, The Rialto

EGYPT.

ALEXANDRIA, The Fouy Palace
ALEXANDRIA, The Cinema Royal
CAIRO, The Palace

FRANCE.

BIARRITZ, The Royal Cinema
BORDEAUX, The Francais Cinema
COURBEVOIE, The Hawk Studios
IRIS SUR SEINE, Gaumont Studios.
LILLE, The Familia Cinema
LYONS, The Bellecour
MARSEILLES, The Capitole.
MARSEILLES, The Eldorado.
MARSEILLES, The Odeon.
NICE, The Paris Palace.
NICE, The Rialto
NIMES, The Colisee
NIMES, The Eldorado
PARIS, The Bijou Studios.
PARIS, The Aubert Palace.
PARIS, The Capitole
PARIS, The Cinemonde
PARIS, The Fox Films Corpn.
PARIS, The Gaumont Palace
PARIS, The Gaumont Studios.
PARIS, The Imperial Cinema.
PARIS, The Lutetia Cinema
PARIS, The Madeleine
PARIS, The Marivaux
PARIS, The Max Linder
PARIS, The Metropole
PARIS, The Mozart
PARIS, The Omnia Pathe
PARIS, The Pigamond Palace
PARIS, The Pathe Studios
PARIS, The Pagode Cinema
PARIS, Messrs Tallans Films
RHEIMS, The Opera House
STRASBOURG, The Broglie Palace.
TOULON, The Petuna Cinema
TOULOUSE, The Paramount Theatre

ENGLAND

BIRMINGHAM, Handsworth, The Regal.
BIRMINGHAM, Hasmills, The Adelphi
BIRMINGHAM, Hockley, The New Palladium.
BIRMINGHAM, The Craven Cinema
BIRMINGHAM, Ladywood, Crown Cinema.
BIRMINGHAM, Snowhill, The Metropole
COVENTRY, The Broadway
COVENTRY, The Gaspd Cinema
COVENTRY, The Grand Cinema
COVENTRY, The Plaza
COVENTRY, The Scala.
KINGSTON, The Hippodrome.
OLDBURY, The Palace
RUGBY, Messrs British Thomson Houston
SMALLHEATH, The Newhoxa Palace.
SUTTON COLDFIELD, The Empress

WILTS.

CHIPPENHAM, The Palace
SALISBURY, The Picture House
SWINDON, The Regent.
SWINDON, The Rialto

WORCS.

DUDLEY, The Criterion
DUDLEY, The Empire
MALVERN, The Assembly Rooms.
MALVERN, The New Theatre
OLDBURY, The Palace
STOURBRIDGE, The Kings Hall.
WORCESTER, The Arcadi.
WORCESTER, The Scala

YORKS.

BARNSLEY, The Alhambra
BARNSLEY, The Empire
BINGLEY, The Cinema
BRADFORD, The Picture House.
BRADFORD, The Regent
CASTLEFORD, The Picture House.
CLECKHEATON Goodalls Pictures.
DEWSBURY, The Pavilion
DONCASTER, The Electric
DONCASTER, The Majestic
DONCASTER, The Picture House.
DUDLEY HILL, The Picture Palace.
HALIFAX, The Electric
HUDDERSFIELD, The Princess.
HULL, The Cleveland Cinema
HULL, The Monica Picture House
HULL, The National Picture Theatr
HULL, The Playhouse
HULL, The Savoy
KEIGHLEY, The Picture House
LEEDS, The Majestic
LEEDS, The Playhouse
LEEDS, The Rialto
LEEDS, The Scala
MIDDLESBROUGH, The Line
MIDDLESBROUGH, The Hippodrome.
MIDDLESBROUGH, The Pavilion
MIDDLESBROUGH, The Scala
RAVENSTHORPE, The Pavilion
SCARBOROUGH, The Cinema
SHEFFIELD, The Palace Cinema
SHEFFIELD, The Picture House
SHEFFIELD, The Scala
SHEFFIELD, The Theatre Royal
SKIPTON, The Picture
WAKEFIELD, The Empire
WOODHOUSE, The Picture Palace

CHANNEL ISLANDS

GUERNSEY, St Julies Hall
JERSEY, The Empire House

SCOTLAND

DENHOLM, The Stobs Hall Cinema
DUNDEE, The Gem Picture House
EDINBURGH, The Playhouse
EDINBURGH, St Andrew Square Pictur. House
EDINBURGH, The Savoy Cinema
EDINBURGH, The Synod Hall
FALKIRK, The Grand Cinema
FALKIRK, The Picture House
LORIMER, The Public Hall Cinema
GLASGOW, The B.B. Cinema
GLASGOW, Bridgeton Picture House
GLASGOW, Britford Picture House
GLASGOW, Cosmo
GLASGOW, Grandora Picture House
GLASGOW, Govan Picture House
GLASGOW, Govan Picture House
GLASGOW, Govan Cross Picture Palace
GLASGOW, Govanhill Picture House

IRVINE, The Picturedrome
JOHNSTONE, The Pavilion
KILMARNOCK, The Empire
KILSYTH, The Kings Cinema
KILWINNING, The Picture House
KIRKCALDY, The Palace
KIRKCALDY, The Port Brae Picture House
LEITH, The Alhambra
MARYHILL, The Regal House
MONTROSE, The Kings Cinema
PAISLEY, The Picture House
PAISLEY, The West End Cinema
PERTH, The Alhambra
PORTOBELLO, The Bungalow Cinema.
ROTHESAY, The Palace
ROTHESAY, The Theatre de Luxe
ST ANDREWS, Golf Club House
SALTCOATS, The Picture House
SANQUHAR, The Picture House
WHIFFLET, The Garden Cinema
WINTON PIER, The Pavilion
WISHAW, The Pavilion
WISHAW, The Picture House

WALES

LLANELLY, The Hippodrome
MERTHYR TYDFIL, The Theatre Royal,
NEWBRIDGE, The Celtsea Cinema.
NEWPORT, The Coliseum
NEWPORT, The Olympia Cinema
NEWPORT, The Pavilion
PORT TALBOT, The Grand Cinema,
RHYL, The Cinema Royal
SWANSEA, The Empire Royal.
WESTPOOL, The Close Cinema.

IRELAND

DUBLIN, The Theatre de Luxe
DUN LOAGHAIRE, The Pavilion
KILLARNEY, The Picturedrome.
LIMERICK, The Coliseum
LIMERICK, The Grand Central
LONDONDERRY, The Midland Cinema
LONDONDERRY, The Opera House
LONDONDERRY, St Columbs Hall
TROUT, The Picturedrome
WATERFORD, The Theatre Royal

CONTINENTAL

GERMANY.

BERLIN, Messrs Fox Films Corpn.
BERLIN, Messrs Warner Bros
BERLIN, The Ufa Studios
GREECE
ATHENS, The High Life Cinema.
ATHENS, The Ideal Salon Cinema.

HOLLAND

AMSTERDAM, Van Damen.

ITALY

MILAN, The Corso Cinema
MILAN, Fotolabo Offices.
MILAN, Pittaluga Offices.
ROME, The Super Cinema.
ROME, Fotolabo Offices.
ROME, The Studios.
TURIN, The Chiesa Theatre.
TURIN, Fotolabo Offices

NORWAY

OSLO, Nedre Slotsgat

RUSSIA

MOSCOW, Pyrove Sovkino.

SPAIN

BARCELONA, The Tivoli
BARCELONA, The Monumental.
MADRID, The Real

SWEDEN

MALMO, The Palladium
STOCKHOLM, The Olympia.
STOCKHOLM, Svenska Filmindustrie.

SWITZERLAND

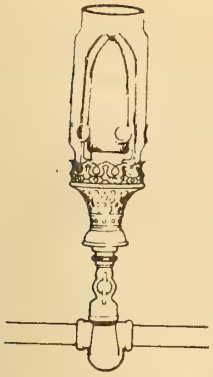
BERNE, The Splendid Palace
PAYERNE, The Casino
ZURICH, The Apollo
ZURICH, The Capitol

TURKEY.

CONSTANTINOPLE, The Grand Opera.

Simplex
The International Projector

THE INTERNATIONAL PROJECTOR CORPORATION
90 GOLD STREET, NEW YORK



Welsbach mantle

has a marked influence upon its efficiency.

"Open Arc" Type

The earlier type of arc lamp was known as the "open arc" because it was designed with the electrodes exposed to the atmosphere. While this lamp was very efficient in comparison with other illuminants of its day and was widely used for street lighting, no redirector was provided to utilize the light normally emitted upward. Consequently, it illuminated a relatively small area immediately adjacent to the lamp to a high intensity while at points a relatively short distance away the intensity was low. Moreover, there was usually a dark spot immediately below the lamp due to the shadow cast by the lower carbon and its support.

An improved type of arc lamp was the enclosed arc wherein the arc was surrounded by a glass globe. Although not airtight, the enclosing globe prevented free access of air to the electrodes with the result that the consumption of the carbons was greatly retarded. While the enclosed arc did not give as much light for the same wattage as the earlier type of open arc, it was unnecessary to make as frequent renewals of the carbon electrodes. As a result it was extensively used for street lighting.

In the original carbon arc lamp, the hot gases in the arc gave off about 10 per cent. of the total light and the remaining 90 per cent. was emitted by the heated carbon electrodes. Later, it was found that if the electrodes were impregnated with certain salts, the arc gases became highly luminous. Thus, for a given amount of electrical energy, the so-called flaming arc lamp which resulted from this impregnation furnished considerably more light. These lamps were handicapped by the necessity for frequent carbon renewals.

Attempts were made to enclose the flaming arc by providing a condensing chamber to remove the solid products of the combustion of the electrodes, but in spite of this a coating formed on the globes and in some cases the globes became roughened or pitted. Because high initial efficiency of these lamps could not be maintained, they did not prove particularly economical and therefore gradually disappeared from use.

More light from the arc was also obtained by using electrodes of materials other than carbon, a notable example being the magnetite arc, some of which are still in use. In the magnetite arc a bar of copper is used for one electrode. The other electrode is a thin steel tube containing a composition of magnetite. Magnetite arcs are of high efficiency. The electrodes are not consumed rapidly, hence they require infrequent trimming. The light emitted is relatively white in color.

Mercury-Vapor Lamp

Another lamp, widely used for photographic purposes and to some extent for industrial lighting, is the Mercury-Vapor lamp, which can be recognized by the characteristic bluish green color of the light. This lamp consists of a long glass tube from which the air has been exhausted and which contains a small amount of mercury in a bulb at one end. An electrode is sealed into the glass at either end of the tube. The arc is started by tilting the tube slightly until a thin stream of mercury completes the circuit between the terminals. Returning the tube to its normal position breaks the circuit as the mercury runs back into the bulb and draws an arc behind it. The heat of the arc soon vaporizes enough mercury to fill the tube and it becomes luminous throughout its entire length.

The peculiar color of the light is due to the presence of a relatively high percentage of green and blue rays and to the absence of red rays. Since photographic emulsions are most sensitive to green and blue, the mercury vapor arc is an efficient illuminant for photographic purposes.

The Neon Tube

When an electric current is forced through certain gases, they become luminous. Neon, one of the rare elements of the atmosphere, is a gas of this type which glows with a rich orange-red light. The Neon tubes used in electrical advertising operate on this principle.

Glass tubes are formed in the shape of letters or any other desired patterns and an electrode is sealed into each end. They are then carefully exhausted of air and a small quantity of neon admitted. Due to the high resistance of the gas, voltages of from 8,000 to 12,000 volts are required to operate the tubes. Colors other than the characteristic orange-red are obtained by introducing small quantities of other gases such as mercury vapor, argon, and carbon dioxide, and by making the tubes of colored glass.

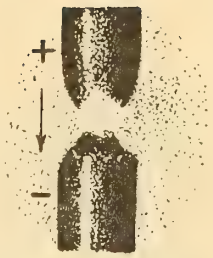
Neon tubes have a bright, vivid, day and night appearance. They consume a relatively small amount of current but have a rather low power factor (about .50).

Hot Cathode Neon Lamps

A recent development in gaseous conductor tubes is the so-called "hot cathode tube." In this device one of the terminals is heated to incandescence. This allows the lamp to operate at a considerably lower voltage and provide a better efficiency in terms of light output per watt of energy consumed. Tubes of this kind have been used for spectacular lighting and for the floodlighting of buildings.



Mercury vapor lamp



Electric arc between carbon terminals

Electric Eye Detects Gas

Not only is every motor car which passes through the Holland Tunnels counted electrically, but a new application of the same electric eye, or photoelectric cell, has now been installed to give warning of dangerous exhaust gases from automobiles.

Warm exhaust gases cast faint shadows across a beam of light, and the minute change is recorded by the sensitive photoelectric cell. This, in turn, by the change of current on the circuit, registers on a dial in the superintendent's office and enables the man in charge to turn a switch to speed up suction fans to carry the gases away.

Fire Extinguishers

For positive results in the operation of fire extinguishers, those containing soda and acid, or foamite solution, must be refilled every 12 months; this is also a requisite of the Board of Fire Underwriters and most cities or municipalities. Those fire extinguishers containing tetrachloride solution are not necessary to refill once each year, but should be shaken up at intervals of every six months. Should only a portion of the content of any fire extinguisher be used, discharge the remaining content and refill. In addition, have placed on each container a tag showing the last inspection or filling.

Outstanding in Labor Ranks, in His Craft, and in Civic Affairs



Thomas E. Maloy

Leader of Chicago Local Union 110, and A. F. of L. Delegate to the British Trades Union Congress.

A Tribute to Thomas E. Maloy

Who, at the age of 35, has been a labor leader for 12 years, a splendid craftsman, a civic leader, a sportsman—and who now has earned the honor of A. F. of L. delegate to the British Trades Union Congress

JUST twenty years ago this June the Chicago Local Union of the I. A. T. S. E. admitted to membership a gangling, awkward boy of 15 and thereby performed an extraordinary service to themselves and to the hundreds of men who subsequently were to become members of this organization. In strict honesty, however, it must be said that to the Local Union officers at that time there was nothing extraordinary about the admission of this youth. He probably represented to them no more than just another member of their unit, just another boy to be taken care of and looked after—looked after in the manner which was then in vogue and which consisted mainly of impressing a new member with his responsibilities to himself and to the organization in a fashion which today might be considered a bit harsh. Such was the procedure in those days, and the system turned out real trade unionists.

Today, twenty years later, this same youth occupies one of the highest places in the American trade union movement. Now only 35 years of age, this same boy has compiled a truly amazing record of achievement: business agent of one of the outstanding labor unions in the country for the past 14 years, delegate to American Federation of Labor Conventions for the past 10 years, known throughout the country as a brilliant and courageous fighter in the interests of labor, a superb executive, a leader in civic activities, a sportsman and gentleman, and finally, to top the list, appointed A. F. of L. delegate to the forthcoming British Trade Union Congress in England—all these and many more too numerous to mention are the accomplishments of Thomas E. Maloy, Business Agent of Chicago Local Union 110 of the International Alliance.

Just how "Tommy," as he is affectionately known to thousands, had time to do all these things is not known. Pressed for the answer to this question Maloy has answered "I do it, that's all." And in this brief reply may be found the key to Maloy's tremendous vitality and ability to get things done. He tackles every problem directly—no hedging, but little talking, and with a maximum of work. He just does it, that's all.



President Canavan and Maloy snapped at Portland, Ore., in 1925

The 1928 Strike Victory

And never was this force of character more aptly displayed than in the citywide shutdown of Chicago theatres in 1928, a shutdown forced by the plans and actions of none other than Maloy who, in the face of threats from the opposing forces that surely this time they would "break him," and "put his organization on the rocks," went quietly ahead with his plans, marshalled 100 per cent support from his Local members, gained the confidence and sympathy of public opinion for his efforts, and ended up by winning an overwhelming victory.

Maloy's campaign in this hard fight was front page copy in newspapers throughout the country. To have lost would have meant disaster, not only in Chicago but throughout the country. But "Tommy" never thought of losing; his plans admitted of no defeat.

Then, as now, Maloy did not permit success to turn his head, to direct his attention away from his real mission in life—the labor movement in general and Local Union 110 in particular. Ascribing the success of the fight to the wholehearted support tendered him by "his boys," Maloy dismissed the incident with the remark the "boys got what they wanted and just what was coming to them."

Tribute from His Own Local

And now, when he has received one of the greatest honors possible in the



A quiet, restful dignity pervades Maloy's private office at Union headquarters

What They Think of Tom Maloy in

Tributes from

The Governor of Illinois

Exhibitors' Assoc. of Chicago

Illinois Federation of Labor

State of Illinois
Office of The Governor
Springfield

LOUIS L. EMMERSON
GOVERNOR

May 19, 1930.

Mr. James J. Finn, Editor,
The Projectionist
45 West 45th Street
New York City, New York.

My dear Sir:

Permit me to say a few words about my good friend, Thomas E. Maloy, Business Representative of the Chicago Moving Picture Machine Operators Union, who has been selected by the American Federation of Labor to represent them in the British Trades Union Congress to be held in Nottingham, England. The American Federation of Labor is to be congratulated upon selecting so capable a young man as Mr. Maloy.

I have watched his progress in the labor movement and can truthfully say that he is a credit to the labor movement both in the City of Chicago and the State of Illinois. I take this opportunity to join with his many other friends in wishing him "Bon Voyage".

Very truly yours,

Louis L. Emmerson

EXHIBITORS' ASSOCIATION OF CHICAGO

910 SOUTH MICHIGAN AVENUE
PHONE HARRISON 0808

PRESIDENT AND BUSINESS MANAGER
J. MILLER

Chicago, Illinois.
May 16, 1930.

Mr. James J. Finn,
Editor of the Projectionist,
45 W. 45th Street,
New York City.

Dear Sir:--

I just want to say a few words about my friend and opponent, Mr. Thomas Maloy.

In all my dealings with labor officials in the past ten years, I have found Mr. Maloy to be a man whose word has never been questioned; a man with whom it has been a pleasure to deal.

My only hope is that we will continue to have Mr. Maloy to do business with as long as I am here to do business with any union officials.

Very truly yours,
EXHIBITORS ASSOCIATION OF CHICAGO.
J. Miller
PRESIDENT

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TOM A. OLANDER - SEC. TREAS.
THOMAS FEELEY - 2ND VICE PRES
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JAMES B. COMING - 4TH VICE PRES

ILLINOIS STATE FEDERATION OF LABOR
STATE BRANCH
AMERICAN FEDERATION OF LABOR
VICTOR A. OLANDER, Secretary-Treasurer
623 South Wabash Avenue
CHICAGO, ILLINOIS

OFFICERS
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JOHN H. SAND - 9TH VICE PRES

Chicago, Illinois, May 16, 1930

Mr. James J. Finn, Editor,
The Projectionist,
45 West 45th Street,
New York, N. Y.

Dear Sir:

At the forthcoming meeting of the British Trades Union Congress in England, the American Federation of Labor is to have as one of its representatives Mr. Thomas Malloy, leader of the Moving Picture Machine Operators' Union of Chicago. I take this opportunity to join with his many other friends in wishing him "Bon Voyage!"

It is fitting that Mr. Malloy, a stalwart American from this great city in the heart of our nation, and representing as he does one of America's largest and most modern industries, should be the spokesman of the vigorous American labor movement in meeting and addressing our British brothers across the sea. He has rendered yeoman service in raising the standard of life and labor in the moving picture industry to the present high level, and thus has not only benefitted the workers in his own craft but, by the example of the splendid results obtained, has encouraged others to similar achievement. I am sure that his visit to the British labor movement as a representative of the American labor movement will be productive of good to the workers and to the moving picture industry in both countries.

Very truly yours,

V. A. Olander

Victor A. Olander
Secretary-Treasurer

VAO:F

Labor and Civic Circles in Illinois

CHARLES W. MADLEY CHAIRMAN
J. PAUL KUHN
G. GALE GILBERT
WALTER H. WILSON
WILLIAM M. BRINEMAN
PHIL W. COLLINS

ADDRESS REPLY TO
130 NORTH CLARK STREET
CHICAGO ILL

STATE OF ILLINOIS
ILLINOIS COMMERCE COMMISSION
SPRINGFIELD

ADDRESS ALL COMMUNICATIONS TO THE COMMISSION

JULIUS JOHNSON
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ASSISTANT SECRETARY
W. M. HAMMOND CHIEF ACCOUNTANT
JAMES R. CLARK SUPERVISOR
GRAIN ONE AND GRADING

May 15, 1930

Mr. James J, Finn,
Editor, The Projectionist,
45 West 45th St.,
New York, N.Y.

My dear Sir:

I want to say a few words about my good friend, Thomas E. Maloy.

We went to school together and even in those days he was something of a leader among the boys. I have watched his progress in labor circles and have a high regard for him and for his achievements.

At all times he has had the welfare of his fellow workers at heart and this, I believe, has accounted for his success. He is a most loyal and generous friend and I wish him all the luck in the world.

Yours very truly,

Phil W. Collins

PHIL W. COLLINS

PWC/H

TELEPHONE SEELEY 4162

PRINTED ON UNION MADE PAPER

JERRY DONOVAN
SECRETARY-TREASURER

TEAMSTERS' JOINT COUNCIL No. 25

I. B. of T., C., S. and H. of A.

220 SOUTH ASHLAND BOULEVARD

CHICAGO, ILL.

May 15, 1930.

Mr. James J. Finn, Editor,
The Projectionist,
45 West 45th Street,
New York, N. Y.

Dear Mr. Finn:

The selection of Thomas E. Maloy as Fraternal Delegate to the British Trades Union Congress is a worthy recognition of an eminent and loyal trade unionist.

For nearly twenty years Tommy has served the Moving Picture Operators' Union in an official capacity. His diplomacy, ability and experience has been a valuable asset, not only to his own organization but to the labor movement in general. There is no organized group of men in America enjoying the conditions and compensation of his organization. This success has been brought about in the main by the sterling leadership and agressive fighting qualities of Tommy.

He has been ready at all times to give moral or material support to any sister local in trouble or distress. The Teamsters and Chauffeurs Organization, of which I am a member, stand ever ready to cooperate, work in accord and harmony with him, being mindful of the fact that he stands for the highest ideals of the Trades Union Movement.

Tommy has represented his organization as a delegate to the Chicago Federation of Labor for a number of years. Leaders in the labor movement in Chicago, taking cognizance of his merits and experience, have councilled his wisdom and advice. The delegates of the Convention, representing the entire Labor movement of America, are to be congratulated upon their judgment in conferring this distinction upon so capable a man.

We bid Tommy "Bon Voyage", a pleasant and profitable journey and a safe return to us. We know that he will acquit himself honorably and prove himself a distinctive loyal American Trades Unionist, assisting in cementing a bond of friendship and fraternalism between workers of America and Great Britain.

Fraternally,

Jerry Donovan

Jerry Donovan,
Secretary-Treasurer,
Teamsters' Joint Council,
I. B. of T. C., S & H of A.

OSCAR E. CARLSTROM
ATTORNEY GENERAL

State of Illinois
Law Department

Chicago Office
1810 1814 FOREMAN-STATE NATIONAL BANK BUILDING
33 NORTH LASALLE STREET

May Seventeenth
1930.

Mr. James J. Finn,
Editor,
"Projectionist,
New York, N.Y.

My dear Mr. Finn:--

I have just been advised that our good friend, Thomas A. Maloy, Business Representative of the Moving Picture Operators' Union, has been selected as a delegate to represent the American Federation of Labor at the British Federation of Labor Convention in London.

It is gratifying to see this recognition coming to Mr. Maloy. For a number of years he has been my friend, and I have always found his loyalty and sincerity to be beyond question. He will ably represent the American Federation of Labor in Europe.

Sincerely yours,

Oscar E. Carlstrom

OEC-E

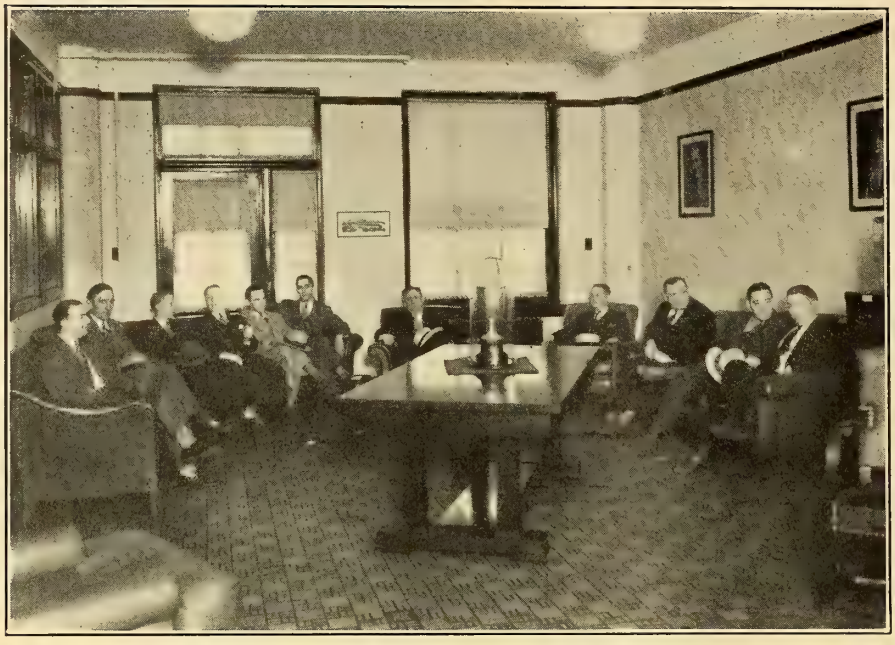
Attorney General.

Tributes from

Illinois Commerce Commission

Teamsters Joint Council No. 25

Illinois Attorney General



Section of comfortable Local 110 members' room

labor movement—that of A. F. of L. delegate to the British Trades Union Congress, an appointment which reflects great credit on himself personally and on the craft which he represents—Maloy turns to find his greatest satisfaction in the tribute of "his own boys" of Local 110. Among the mass of tributes which have been pouring in to him ever since his selection as a delegate to England—tributes from men high in political life, the arts and sciences, the industrial and commercial worlds, amusement field leaders, and those high in social life—the most prized tribute of the lot is that from the members of his own organization for whom he works. Just what his own boys think of "Tommy" is apparent from the following:

Tribute to Thomas E. Maloy from the membership of Chicago Local Union 110 *of the I. A. T. S. E. & M. P. M. O. U.*

Thomas E. Maloy came to us in a time of great stress, at a time when the need of an able leader was acute. An extraordinary situation existed and only an extraordinary individual would suffice. Our crying requirement in that dark hour fourteen years ago was conciliation—to be saved from ourselves, as it were. A depression in our business affairs had reached a very serious stage indeed, harmony was lacking, real friendships few, and to begin all over appeared our only salvation. To do that we would have to set our divided house in order. And then came from our ranks a young man, a boy almost, who so conducted himself that he was looked upon in the light of a savior.

Due to his broadness of vision, definiteness of purpose, unswerving loyalty to his adopted cause—our cause—his untiring and ceaseless efforts, we are well on the way toward a full realization of our quest of peace and happiness and that which rightfully belongs to us. Under his leadership lost ground has been restored, friendships cemented, and more strongly than ever before, a finer understanding between employer and employee has developed, all contributing influences to the welfare and development of our craft. Through his advanced ideas and originality of application, fair dealing and utter fearlessness in the prosecution of a just policy, he has gained the esteem and friendship of the people of this community. We honor one whose qualities have earned so many high honors—Thomas E. Maloy, Business Representative of Local 110, I. A. T. S. E. and Fraternal Delegate to British Trades Union Council.

Local 110 Model Organization

Maloy has truly earned this high regard of the members of his organization. Although it took years of hard work to accomplish it, Local Union 110 is organized 100 per cent. Its present unity is the result of years of hard organizing work, fighting, educating, building.

Today Local Union 110 is as compact and efficient as any highly organized commercial enterprise. A visit to its headquarters reveals well-laid out offices, neatly furnished. Business is carried on with exactness and promptness, and the Local Union is altogether a smooth running, well geared machine, alert to its problems and quick to recognize any defect in its structure.

Thomas E. Maloy is the presiding genius of this organization, and his influence within the craft extends throughout his own and neighboring states. He personally dominates Local Union 110, and he has employed wisdom and discretion in his choice of officers with which to work. Even the most casual observer could not fail to be impressed by the power and organization of Local Union 110. And the organization today is indebted for its fine condition mainly to "Tommy" Maloy for his work during the past years.

An index to the high regard in which Maloy is held by the trade union leaders in America may be had in the report of the proceedings of the last Convention of the American Federation of Labor in Toronto, Canada, where Maloy was selected as one of two delegates to the British Trade Union Congress.

Maloy's name was placed in nomination at the convention by Daniel Tobin, President of the International Brotherhood of Teamsters. In nominating Maloy, Tobin said, in part:

"In the selection of the delegates to bring a message of good will the greatest care should be exercised to select the best men. Very often in our conventions we are swayed by sympathy and good will, and sometimes we overlook those who might serve us in the positions to which we select delegates.

"I have the pleasure of presenting to the convention the name of a young man who has been tried and trained in more than one battle in labor's interest, whose organization stands out as second to none in obtaining conditions for its membership, and in holding the respect and confidence and approval of all trade unionists in America.

"This young man is representing the International Union of Theatrical State Employes. No organization has made the progress this organization has made in the last twenty years, and no part of the country has progressed economically more than this man's organization in the City of Chicago. I say that in my judgment the man to select and send over at this time is Thomas E. Maloy."

Maloy's nomination was quickly seconded by a delegate of the Sheet Metal Workers' Union; and then President Canavan of the I. A. T. S. E. & M. P. M. O. U. added his second in the following words:

"I could not let this opportunity slip by without adding my second to the nomination of Tom Maloy. We present him as a distinguished member of our organization and an outstanding figure in the trade union movement. I trust you will give him consideration when you cast your vote."

Maloy received the united support of the Building Trades and was named as delegate by an overwhelming vote in his favor. His co-delegate is John J. Manning, president of the Union Label Trades Dept. of the A. F. of L. and an outstanding unionist of great ability. The delegates will sail on July 11 on the *Ile de France.*

Chicago Testimonial Banquet

A testimonial banquet will be given for Maloy at the Hotel Stevens, Chicago, on June 21st. Testifying to Maloy's wide range of activities and the many friends he has gained in all walks of life is the list of committeemen for the banquet which is as follows:

Oscar Carlstrom, attorney general, State of Illinois; Dr. Karl A. Meyer, medical director, Cook County Hos-

pital; G. W. Schick, past commander, American Legion; Attorney Thomas Nash; E. D. (Jack) Miller, president, Exhibitors' Association of Chicago; Captain Michael O'Grady, Chicago Police Department; Alderman John P. Wilson; George E. Brown, vice-president, I. A. T. S. E.; Dan Serritella, City Sealer; Frank O'Neill, secretary, Oak Park Elks, 1925; J. Siegel, president, General Markets Corp.; P. J. Berrill, vice-president, I. B. T. S. and H. of America; James Coston, National Theater Corp.; William Baron, vice-president, Movie Supply Company; George L. Carrington, installation manager, Electrical Research Products, Inc.; Boone Mancall, Motion Picture Projectionist; John Balaban, Publix Theater Corp.; U. J. "Sport" Herman, Cort Theater; William Martin, president, Kenwood Trust and Savings Bank; Phil Collins, Illinois Commerce Commission; Judge Lyle, Municipal Court of Chicago; Thomas Reynolds, president, Local No. 110, I. A. T. S. E.; Peter Drautzburg, United States Secret Service; Henry Schoenstadt, Schoenstadt's Theater Corp.; Alderman William Pacelli; John Garrity, Shubert's Theater; Rev. R. J. Ashenden; Isaac Powell, president, South Side Trust and Savings Bank; Judge John Lupe, Municipal Court of Chicago; W. E. Green, president, National Theater Supply Company, and Thomas Flannery, president, White Way Electric Sign and Maintenance Company.

Apart from his trade union activities, Maloy has distinguished himself in civic and fraternal endeavors. He is a member of various fraternal organizations, and was recently made a life member of Oak Park Lodge No. 1295, Order of Elks. His activities in the various fraternal orders of which he is a member, particularly in the charitable enterprises of these organizations, has gained for him a wide popularity in Chicago.

Maloy a Noted Sportsman

Despite these constant demands upon his time, Maloy is able to devote some time to outdoor sports, in which he is keenly interested. He is an accomplished horseman and a great lover of blooded horses. One of his prized possessions is *Margaret McDonald*, prize mare which is valued at more than $50,000. This horse has won many notable blue ribbons for Mr. Maloy, the scene of her greatest triumphs being the South Shore Country Club in Chicago, where she has been a constant winner. This fine animal also ran up a great score at the International Live Stock Exposition at Chicago last year, where she won two firsts and two seconds.

Many overtures have been made to Maloy for the purchase of this mare, but he has turned a deaf ear to all such proposals, preferring to keep and show the mare for the pleasure he gets out of the ownership of such a fine animal.

Other sports in which Maloy is interested are polo, hockey, baseball, football and boxing, the latter sport having engaged his attention some years back when he undertook the management of several boxers in his spare time. Maloy's fighters were noted for their fast, clean fighting, and they always went into the ring to give their best and to win.

Philanthropic Work

No committee for a charitable enterprise in and about Chicago is considered complete until the services of Maloy have been enlisted. His services are always on the market in such enterprises, and various Chicago philanthropic societies have ample reason for remembering Thomas E. Maloy.

This brief biographical sketch can hardly begin to enumerate the career of Tom Maloy, but it will serve as an index to the remarkable man that he is. His forthcoming trip to England as A. F. of L. delegate reflects great honor on himself, on his fellow craftsmen and on the International Alliance organization. Projectionists in particular and labor union men in general have reason to be thankful that such men as Thomas Maloy are enlisted in their cause.

At the great testimonial banquet to Maloy on June 21st in Chicago there will be many noted figures who will pay tribute to Maloy as a labor leader and as a man; but one thing is certain: through the days of feting and toasting, through the days he is in England, and through the years to come, Maloy will retain those very same attributes which have brought him to his present high place. "Tommy" he is to all those who know him, and "Tommy" he will remain. Local 110 will continue to reap the benefits of his tireless efforts in its behalf, and the American trade union movement will be the richer for his new experiences.

Maloy's noted thoroughbred

Margaret McDonald

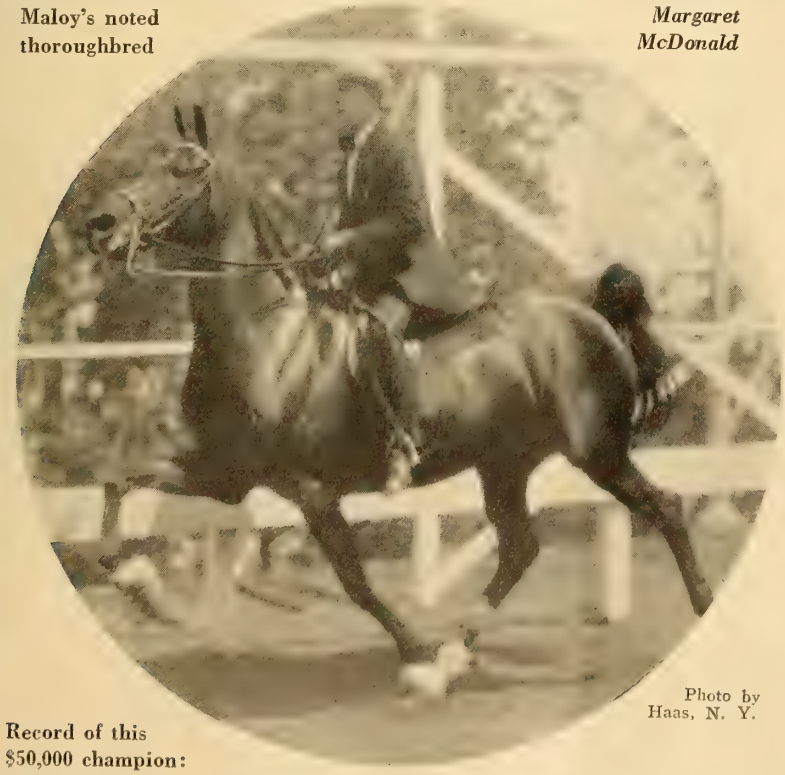


Photo by Haas, N. Y.

Record of this $50,000 champion:

Firsts in mare class, combination class, and model class; 2nd in fine harness class—South Shore Country Club, Chicago. Firsts in ladies class, fine harness class; and 2nds in combination class and model class at International Live Stock Exposition, 1929.

Audiometer Test

In the belief an observation of an audiometer test—which was reported herein recently—might be of interest to many, there is quoted here a report made by E. W. Sharp, manager of Fox Theatre at San Bernardino:

"A rather interesting experiment was made recently at the Fox Theatre. All employees in the Orange Belt were given a hearing test by ERPI Service Engineer, Ray Welmert. His test was made with an Audiometer, an apparatus that discharges frequencies from 64 to 8,000.

Shows Wide Variation

"It is very surprising that there can be so much variation in different people's hearing. Some of the 'victims' had normal hearing through the entire range of frequencies. Others were below normal on the lows and normal on the rest. Some were normal on the lows and highs, but dropped considerably in the middle register. Others were normal up to 5,000, but then went way below normal on the higher frequencies.

"The test was given in the interest of getting the most out of our sound pictures, and all in all, it proved quite informative."

As The EDITOR Sees It

¶ *The 30th I. A. Convention*

MEMBERS of the International Alliance have been looking forward to the Thirtieth Convention at Los Angeles. For it is at this meeting that many questions of great importance to the welfare of the general membership will come up for discussion and settlement. We are of the opinion that the Thirtieth Convention will be productive of much good and, possibly, a few surprises. Concerning the latter, however, we prefer not to essay the role of a prophet but to content ourselves with reporting in detail in the next issue the work actually accomplished. I. A. members may be sure that their best interests will be the primary consideration of the delegates.

We can think of no more appropriate time than the present to direct the attention of projectionists to the splendid work performed by the I. A. General Office year after year, in season and out. We wonder just how many times during the year the rank and file of Local Unions look beyond their own provincial interests and give a thought to the parent organization which is in a large measure responsible for the present fine condition of many Local units. The work accomplished by the General Office so faithfully, so consistently, isn't one of those things that "just happens." On the contrary, it is a result of many hours of hard work by the appointed officers.

It seems to us that it would be of decided benefit to all I. A. members to give an occasional thought to the work performed by the General Office and to be deeply grateful to those men who are serving them so well—often at great personal sacrifice. A proper understanding and appreciation of this work undoubtedly will serve to make a better Local Union member. And one of the best means of demonstrating this appreciation would be to faithfully discharge one's duties in such a manner as to lighten the labors of both the General Office and the Local Union. A detailed explanation of this process is hardly necessary.

To return to the 30th Convention, we wish at this time to congratulate the General Office officers for their superb work during the past two years; we wish to extend our good wishes to the many fine craftsmen who will assemble at Los Angeles as delegates; and we wish to congratulate the West Coast district which has been doing things in such excellent fashion of late as to merit the honor of playing host to the 30th Convention.

¶ *Wide Film Waits on Sound, Color*

THE expected activity in the wide film field has not materialized because of a number of reasons. First and foremost is the fact that no standard width has as yet been agreed upon by the various organizations interested in this development. We admit to a misstatement in a recent issue where we said that 68 mm. had been agreed upon as standard. No such agreement was reached. A sub-committee of the S. M. P. E. has been working on the problem of wide film standardization for the past three months, but numerous conferences with producer representatives and technical men failed to produce the answer. It now looks as though 70 mm., the Grandeur size, will be adopted as standard.

But there is another reason for the unwillingness of producers to go ahead with work on wide film. Several leading producers are said to have expressed the view that they would much prefer that sound and color be put on a more satisfactory basis technically before proceeding to wide film. Warner Bros. are reported to have had an experimental wide film projector made up but are simply marking time pending developments in the fields of sound and color.

Under these circumstances it is probably to the advantage of the motion picture business as a whole that production work on wide film be held in abeyance some little time yet, during which period all hands may concentrate on the twin problem of sound and color.

¶ *A Showdown on Patents*

DOWN in Wilmington, Delaware, as these lines are written, is being waged a legal battle which is regarded as the last move in the chess game of sound motion picture patent rights which has been in progress now for more than three years. The defendant in the present suit is the Stanley Co. of America, exhibition organization; and the plaintiff is General Talking Pictures Corp., distributors of De Forest Phonofilm sound apparatus. Because the suit involves certain patents in which they are keenly interested, Western Electric has aligned itself on the side of the defendant and has marshaled a glittering array of legal and technical talent for the fray. The circumstances attending the suit are propitious for a final settlement of the issues involved: The law firm of Darby & Darby, counsel for the De Forest interests, is an old hand at sound picture patents, and Dr. De Forest himself is present at the trial. Western Electric is represented by the best counsel available. And, to round out the almost perfect setting for the event, the trial will be presided over by a judge who is fully cognizant of all developments in the art.

This, then, is the picture. The Reis slit patent, owned by De Forest, is the basis on which the battle will be waged. Readers of this publication will remember the exhaustive discussion of slits, slots, and orifices which appeared in these columns not so long ago, from which an accurate idea of the lineup at the suit may be had. The outcome of this suit is of extreme importance to the motion picture industry, for if De Forest wins, he will be in a position to exact royalty from every sound motion picture apparatus now installed. Such action would precipitate an upheaval in the amusement world. . . . May the best man win and thus put an end to this constant bickering over patent rights.

Screen Light and Projector Heat

By J. McD. BURNETT

A CINEMA screen providing a picture showing detail in the shadows, and so acceptable to an audience, must be supplied with light sufficient to allow it to reflect a certain and definite amount of luminosity. Beyond that necessary amount, and today a picture only given that luminosity would be considered badly presented, experienced projectionists differ regarding the brilliance to be attained. Some authorities consider too much light is bad for the eyes and affirm a bright screen causes headaches and is prone to keep patrons away from the theatre. On the other hand, it is definitely established that the more light there is thrown back by the screen the more plastic are the moving figures, the more steroscopic the views. High luminosity appears to be a step in the direction of showing pictures in relief, and provides a show more satisfying to the critical portion of the audience.

The amount of light reflected from the screen can be controlled. The projector arc is the source of the light, but, as I will show, other factors determine the capacity of the arc. The screen itself has, necessarily, a great influence on the amount of light returned to the audience.

Screen Luminosity

This reflected light, which, so far as the audience is concerned, is the only light that matters, can be measured. The standard of measurement is the foot candle, which is the illumination produced by the light of a standard candle on a normal surface one foot square and a foot away from the source of light. The usual illumination of screens in the old days was about 4½-foot candles, which was about sufficient to show all the details of the picture.

The mirror arc was introduced with the object of keeping the same luminosity on the screen, but economizing the current; but the greatly enhanced value of the brightly lit screen made possible by the new invention altered the objective of its use, and now it is adopted solely for the amplification of the light. Today the luminosity of screens is from 7½ to 17½-foot candles, and the average amount of light from the screen is about twice that of the early days.

Light—More Light!

When auditoriums of greater capacity were built, much larger screens became necessary. These, in order to keep to the standard of luminosity, entailed an enormous call upon the projector for more light. To appreciate the magnitude of the demand, we may assume a screen measuring 4 ft. by 4 ft. reflecting 4½-foot candles; the area is 16 square feet and the light reflected from the screen is equal to 72 candles. If the illumination is of the order of 10-foot candles, the reflection equals 160 candle power. But when we double the linear dimensions of the screen, making it 8 ft. by 8 ft., it measures 64 ft. square, and it reflects at the 10-foot candle rate 640 candle power. Screens now in use measure 24 ft. by 32 ft.; with the same reflected luminosity their 768 square feet give a light of 7,680 candle power.

What candle power the arc has to supply depends on another factor. Large auditoriums require large screens, but they usually entail a much increased distance between the film and the picture. Doubling the distance of projection means quadrupling the candle power at the source in order to have the same intensity of light thrown back from the screen. Going back to our example of the 8 ft. by 8 ft. screen reflecting 640 candle power, we can assume that the projector was 100 ft. away and reflected all the light that left the lens; but if the projector was moved back to 200 ft. from the screen it would have to develop 2,560 candle power to provide light enough for efficient screening.

How Light Is Absorbed

Sound pictures require screens permeable to sound. The most efficient of this type do not reflect more than 60 per cent of the incident light rays. They have, therefore, placed a demand upon the projector for an increase of 30 to 50 per cent more light than that required by the solid screen. With the coming of the colored film, the call for more light will be insistent. In this case, the loss of light is felt at the source. The color in the film absorbs 20 to 40 per cent of the light thrown upon it by the condenser and, when the color films are combined with sound and talking effects, and projected from the front, the light will have to be greatly increased or the value of the picture diminished to that of the old lithographed pictures of the magic lantern days—pictures that were as flat as the screen.

When we consider that all this light has to be generated in the crater of the arc, we are not surprised at the continued growth of the current consumption. Amperages of 12 grew to 18; this rose to 24, to 36; now an arc taking 80 amps. is quite common and in the near future we may expect to see this exceeded, and 150 or 250 amps. for a colored talking film may possibly be necessary. This will probably entail entirely new wiring in most halls, probably new generating plants in many.

Arc an Electric Furnace

Now a projector with such an arc is nothing less than a small electric furnace; the waste heat from it is sufficient to warm efficiently a small hall. An hour's run on such a machine generates heat enough to boil 17 gallons of water. It will heat, provided there is no radiation, a ton of cast-iron to a temperature at which the film melts!

Now the light from the arc is concentrated by the condenser lenses to a circle of only 36 mm. diameter upon a surface of one of the most inflammable substances known; so it is fortunate that glass is a substance with a great reluctance to allowing the passage of heat. Were the heat rays able to pass through it as freely as do the light rays, no film manufactured from any suitable substance we know today could be used; there would be no cinematography. As it is, enough heat passes through to cause, when concentrated, a continual menace of fire and often serious accidents.

Absorption and Radiation

All substances absorb heat when near a source of it until equilibrium is reached; they also radiate it again until equilibrium is attained. A bar of iron placed in a heat ray will rise in temperature until the radiation from it into the air balances the amount of heat it is taking from the heat ray. Raise the temperature of the surrounding air, and temperature of the iron rises; lower it and the temperature drops, or send a blast of air across the bar and carry the absorbed heat away by what I may term forced radiation, and the iron drops to little above room temperature.

On the other hand, place the iron in a niche in a fire brick, which conducts heat badly, and it will be found that the heat of the iron increases regularly with the minutes that have elapsed, until its temperature approaches that of the heat ray itself.

By this we see time is a function in the absorption of heat. With no radiation, a substance in a heat ray absorbs twice as much heat in two seconds as it does in one; to which fact is due the trouble when a film sticks in the gate. Passing through at its normal speed it does not absorb enough heat to fire; passing out it radiates what heat it has absorbed to the air. But when it sticks, or when a small piece torn from the film

sticks in the gate, that absorbs the heat until it reaches firing point and the damage is done.

Possible Cooling Methods

A blast of air in the light path between the condenser and the screen will carry away much of the heat, but it is probable that machines of the future will require a gate channelled for water circulation, which is the most effective method of cooling. The arc chamber will probably be surrounded by a water jacket, and much of the heat generated is certain to be absorbed at its source.

By efficient water jacketing and cooling, projectors can be run at temperatures which can be regulated so that no distortion of lens or film occurs; the life of the machine is lengthened and small mechanical troubles are greatly reduced in number. Safety, however, is the great essential, and with high power arcs it seems certain that it will be absolutely necessary to devise some means, whether by water circulation or air blast, to carry away the heat generated in such great quantities.

Effect of Colored Motion Pictures on the Eyes

By DAVID LEVINSON

HOW does the colored moving picture affect the eyes? The answer to this timely question is generally thought to be that colored pictures as they are now made and projected tend to produce eyestrain, while, in fairness to producers and projectionists, it can be added that a great deal of effort is being expended to perfect the colored moving picture so as to eliminate such unfavorable reactions on the part of the eyes as is now to be noted when one has attended a colored moving picture show.

The optical and mechanical principles upon which the more popular colored moving pictures of the day are made include, for the most part, the photographing of a scene through a lens, directly behind which is a prism. Light striking this prism separates equally the images produced from the lens, which then pass through colored glass filters of red and green, or variations thereof, and are registered upon film sensitive to color. The images having registered, the film is developed and emerges as a smooth processed material.

The next step in the manufacture of the film is to superimpose one strip of film upon the other, so that the images of the one will fit perfectly over the images of the other, the two films being held together by an emulsion. With the projection of the two films thus in place, the principle of physics involving complementary colors is then maintained and shades of red and green and their complements are brought into play as natural colors before the eyes of the audience.

Present Limitations

The present limitation of colored pictures to shades of red and green and their complements is perhaps, the most uncomfortable angle of the whole matter to a picture audience. The effect of constant concentration upon the same colors for any appreciable length of time naturally tends to produce strain and to make those colors objectionable and monotonous, even if blending these colors together yields the most attractive of scenes.

Another objection to the colored moving picture is the noticeable effort it takes to make out the details of a picture of this sort when it is projected upon the screen. The complaint is that the greater part of a colored moving picture seems to be covered by a sort of hazy screen, which must be penetrated with considerable effort before it is possible to make out the details. This difficulty is no doubt caused by the emulsion between the two films and to some extent, at times, by the failure of the projectionist to regulate his light properly, which should be "stepped down," as it is called, to a point where the maximum of "softness" will be produced.

I have it on good authority that the focusing of a colored moving picture properly requires much more understanding and skill than does the screening of a black and white picture, the contrast between the black and white being more easily produced than the shading of colors into a favorable spectacle.

Eliminating Fringes

Regulating the movement of tone of light on a colored picture has a great deal to do with the effect that the picture will have upon the eyes. From the start, the prism must be so set and the light so directed to and through it as to produce images upon both films absolutely with no more movement connected with one than with the other, so as to cut out the fringes so unpleasant to the eye.

A lighting arrangement should also be produced to introduce more of the shadow background, by throwing light on the picture from a central source and letting it fade away by cause of its natural diminution, so that much glare will be removed and a softer and more natural artistic result will be projected.

The manufacturers of colored moving pictures are working hard to give to the public a product that will be more pleasing and smoother to the eyes. At the rate they have been going with this type of picture, it should not be long before such objections as the colored picture now presents will be eliminated.

New York Curbs Injunctions

(I. A. General Bulletin, No. 250)

NEW YORK has partially curbed the abuse of the injunction in labor disputes by enactment of legislation providing that hereafter no injunction can be issued by any New York State judge except after notice to the parties against whom the injunction is sought and a hearing in court. The measure was passed as the result of a ten years' campaign by the New York State Federation of Labor. Governor Franklin D. Roosevelt has signed the measure, making it law.

In a statement on the passage of the bill, the New York State Federation of Labor says:

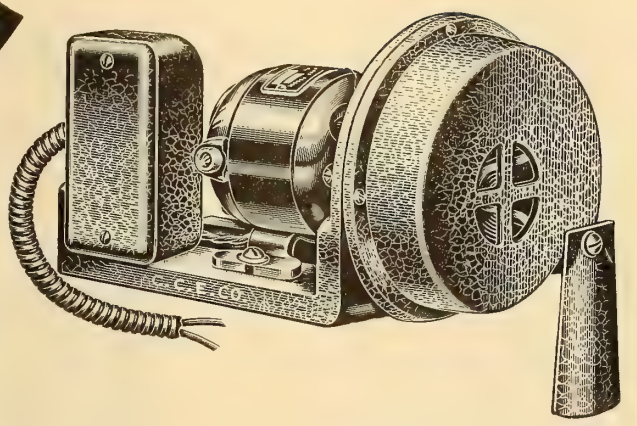
"No injunction can hereafter be issued in the State of New York by a judge of any of its courts except after notice to the parties against whom the injunction is sought and a hearing in court. This is the beneficent result of a campaign instituted by the Federation ten years ago and conducted vigorously ever since to end the ex parte injunction."

The injunction measure, known as the Hofstadter-Lefkowitz bill, was passed by unanimous vote of the Senate and House. The bill, while not all that labor hoped for, was accepted by the State Federation of Labor because it contains the main feature of the Byrne-Lefkowitz bill which was introduced at the opening of the legislative session on behalf of the Federation.

The Hofstadter-Lefkowitz bill puts an end to the evil practice of issuing injunctions without notice and a hearing and allows both sides to be heard before an injunction can be issued. Heretofore injunctions have frequently been issued on application of the employers, supported by affidavits which attorneys for the workers have had no opportunity to challenge.

Governor Roosevelt in his message to the Legislature on January 1, recommended legislation providing for "prohibition against the granting of temporary injunctions without notice of hearing, in industrial disputes, with provision for trial before a jury of any violation of injunctions when granted."

Always ahead of the rest Always the best!

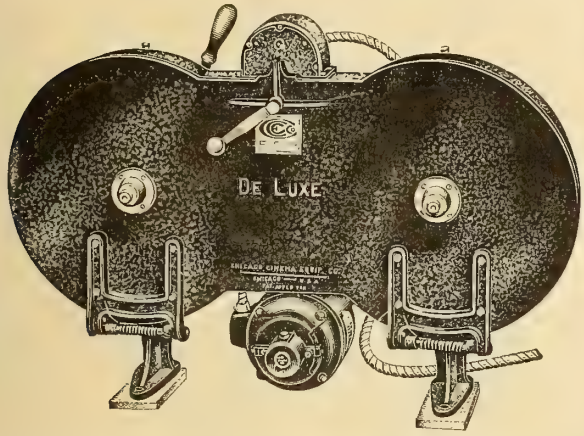


HELP PREVENT FILM FIRE AND BUCKLING WITH THE NEW IMPROVED CHICAGO CINEMA FILM COOLING SYSTEM—ELIMINATES SOUND DISTORTION DUE TO WARPAGE OF SOUND TRACK.

THE simplest device yet manufactured and the easiest to install and operate on Simplex and Motiograph heads—no drilling, replacing of parts or remodeling of your old head when installing. Does not occupy any necessary space. Will not interfere with film threading, framing or any adjustments or repairs while in operation. No exposed moving parts. Does not add to the cost of repairs, as it is not necessary to take off any parts when repairing head. Lengthens life of aperture gates and asbestos heat shields with the consequent reduction in cost of replacements.

Film temperatures are reduced considerably when using the CHICAGO CINEMA Film Cooling System, thereby lessening fire hazard, and also lengthening film life by preventing buckling and warpage. It eliminates sound distortion by preserving the sound track.

This system consists of a scientifically designed centrifugal impeller driven by a Universal motor and mounted on an aluminum base which is readily attached to any head. On the Simplex head, this device slips into grooves provided for stereo attachment.



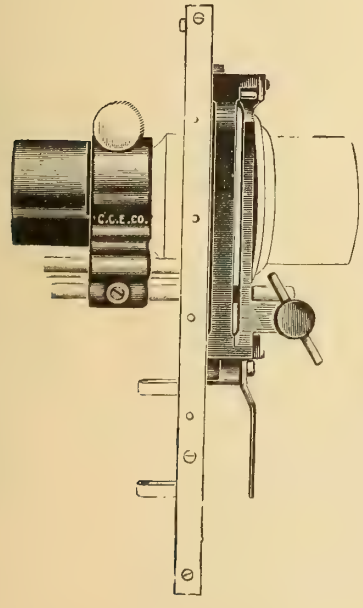
Approved by Underwriters' Laboratories
THE ORIGINAL AUTOMATIC, ENCLOSED REWIND

DE LUXE AUTOMATIC REWIND

TRULY automatic in every respect, the De Luxe Automatic Rewind provides for the rewinding of film with every provision for safety, speed, efficiency and adjustment.

Place the reel of film in the De Luxe Automatic Rewind, shut the door—the film is totally enclosed and the rewinding process takes place automatically; operation stops the instant all the film has been wound, or if the door is opened. Should a break occur in the process of winding, operation ceases and the break is instantly located. Mechanical winding means uniform tension on the film. The tension is adjustable by means of a friction clutch.

Preference for the De Luxe Rewind is evidenced by its widespread usage throughout the country, in every state, in most of the newer and more progressive houses. Approved by the Underwriters' Laboratories as possessing the safety requisite to use in projection booths, tested under extreme conditions far in excess of what would be imposed upon it in normal use, this product of the CHICAGO CINEMA EQUIPMENT COMPANY offers the utmost in modern safety appliances for projection booths where only quality equipment is permissible.



*See our ad. on page 56

ADJUSTABLE LENS HOLDER

FOR POWERS — SIMPLEX — MOTIOGRAPH

(Mention Your Equipment)

INCORPORATES quick lens change, side movement by simple lever control for centering the image, and accurate focusing adjustment. The mounting bracket of the device carries a clamping ring which engages the lens barrel by means of a split collar tightened by a convenient thumbscrew. Lenses may be changed instantly, focused and shifted over into position for projecting normal or sound film in less time than it takes to tell it!

Side movement of the lens holder in shifting the optical center is limited by an adjustable stop screw. A single adjustment assures repeated automatic centering merely by manipulation of the lever outside the head.

The initial focusing adjustment will suffice for subsequent operation, in that it is the general practice to place a reference mark on each lens barrel to indicate its depth of insertion in the holder.

To illustrate operation of the device, a change from Vitaphone to Movietone is effected by shifting the lever and substituting a ½″ shorter focus lens system for that in place. No further adjustment is necessary. Your pictures are both focused and centered.*

Light weight, compactness, sensitivity and sturdiness feature this unit, constructed with precision from aluminum and bronze. Heavy nickel plate and durable black enamel comprise an appropriate finish.

CHICAGO CINEMA EQUIPMENT COMPANY
1748 N. SPRINGFIELD AVENUE, CHICAGO, ILL.

Advisory Council Merit Award to Nat D. Golden

NATHAN D. GOLDEN, Assistant Chief of the Motion Picture Division, U. S. Department of Commerce, and member of Cleveland Local Union 160, was the recipient of the first annual merit award by the Projection Advisory Council in recognition of his services to projection and projectionists during the past year. Presentation of the award—a gold medal on which was engraved the name of the recipient and the donor, in addition to a brief resume of the services performed by Mr. Golden—was made in Washington, D. C., on May 6th.

P. A. McGuire, Executive Vice-President of the Council, represented President Thad C. Barrows, who was unable to be present, and the Board of Directors of the Council. Congressman William P. Connery of Massachusetts acted as master of ceremonies, and the presentation was made by Senator David I. Walsh of Massachusetts.

P. A. McGuire opened the ceremony on the Capitol steps by reading the resolution of the Council authorizing the award. In making the presentation, Senator Walsh read the award resolution:—

WHEREAS, Nathan D. Golden, for many years a member of Cleveland Local No. 160, having suffered from severe wounds while in the service of our country during the World War, which wounds resulted in the loss of a leg, and

WHEREAS, Nathan D. Golden, still an honored member of Cleveland Local No. 160, through his own ability, determination and courage has risen to a position of importance and responsibility as Assistant Chief, Motion Picture Division, U. S. Department of Commerce, thereby rendering a real service to the entire motion picture industry and reflecting credit on his fellow projectionists, and

WHEREAS, he has been of inestimable service to the Projection Advisory Council since its inception, giving advice, encouragement, and assistance to the organization,

RESOLVED,, that the work of Nathan D. Golden is deserving of recognition as a part of the plan and purpose of the Projection Advisory Council "to suitably recognize and work for the advancement of projection or an act of meritorious service performed by a projectionist," and that an appropriate testimonial be given by the Projection Advisory Council as a tangible evidence of his sacrifice and accomplishments.

Victor Welman, B. A. of Cleveland Local Union 160, represented Golden's home local and brother projectionists. Also present at the ceremony were government officials, manufacturers, engineers, projectionists and press representatives. A photograph of the group at the presentation is reproduced herewith.



Scene at presentation of P.A.C. award to Nat Golden on Capitol steps in Washington. Among those present were: 1—J. Flannagan, Pathe News; 2—E. J. Brock, Best Devices Co.; 3—Harry Kravitz, L. U. 306; 4—V. Welman, B.A., L. U. 160; (A)—J. Russell, Hall & Connolly; 5—J. Cameron; 6— G. Edwards, Amer. Projec. Soc.; 7—Congressman W. Connery of Mass.; 8—C. F. Jenkins, founder, S. M. P. E.; 9—Senator David I. Walsh of Mass.; 10—James J. Finn, M.P. Projectionist; 11—P. A. McGuire, Int. Projec. Corp.; 12—Nat Golden; 13—C. E. Curle, Chattanooga, Tenn.; (B)—C. J. North, Chief M.P. Div., U. S. Dept. of Commerce; 14—Samuel Wein; 15—L. A. Townsend, Publix, N. Y.; 16—W. Kunzmann, Nat. Carbon Co.; 17—H. Griffin, Int. Projec. Corp.; 18—Joe Cifre, Boston; 19—H. Strong, Strong Elec. Co.; 20—J. A. Lyons, Nat. Film Renov. Co.; 21—R. Miehling, Univ. Sound Corp.; 22—O. F. Spahr, Enterprise Optical Mfg. Co.; (C)—A. J. Dickinson, M. P. P. D. A.; 23—S. Dworsky, Dworsky Film Mch. Co.; 24—G. Hammond, Brooklyn Strand Theatre.

Methods of Measuring Resistances

By JOSEPH CALCATERRA*

THERE are innumerable ways of measuring resistances, and a few of these will be described in the following paragraphs, more to illustrate the adaptability of electrical instruments and the interesting applications of electrical laws than for any really practical value of the methods. Of course, in some cases they will prove very useful in emergencies where other measuring instruments are not available, but they serve more as examples of electrical juggling and the use of makeshift instruments.

The method shown in Fig. 1 illustrates how a resistance can be measured by means of voltmeter and battery. For maximum accuracy the battery should be of a value such as to give practically full scale deflection of the meter when the test points are connected together, thus connecting the voltmeter directly across the battery. The resistance to be measured is then connected between the test points. For low values of resistance, a low resistance voltmeter will give most accurate results. For high values of resistance a high resistance voltmeter should be used.

The resistance is measured by first taking the reading of the battery by connecting test points T1 and T2 together. Then connect the unknown resistance between points T1 and T2 and take the voltmeter reading.

The resistance value is obtained by using the following formula:

$$Rm \left(\frac{E}{E1} - 1\right) = R$$

Where Rm is the total resistance of the voltmeter (ohms per volt times maximum voltage on the scale), E is the voltage read with the test points connected together (voltage of the battery), and E1 is the voltage reading with the unknown resistor, R, connected between points T1 and T2.

Resistance values can be measured fairly accurately by comparison with standard resistors. A decade box, which can be adjusted, forms the best type of standard to use in such instances.

A circuit consisting of a battery, B, a milliammeter or ammeter, A, and test points, T1, T2, T3 and T4, with a switch, S, are arranged as shown in Fig. 2. A standard resistance, Rs, is connected between test points T1 and T2, while the resistance to be measured is connected between points T3 and T4 as shown. It is important in circuits of this type that the ammeter be capable of covering the range of current that will be drawn when very low values of resistance are connected in the circuit.

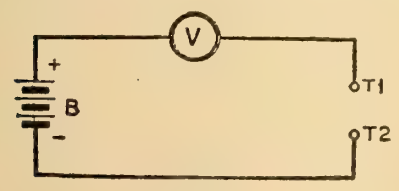


Figure 1

In making preliminary tests it is advisable to connect a protective series resistance in the circuit to protect the measuring instrument. This protective resistance can be a variable high resistance whose full resistance is connected into the circuit at the start and which can be gradually reduced and finally shorted out when it is found that the resistance under test is sufficiently high to limit the current to within the range of the instrument.

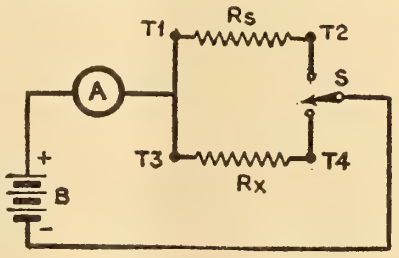


Figure 2

Another very simple method of protecting the measuring instrument is to use a potentiometer across the battery. By this means the voltage applied to the circuit can be increased gradually and the current kept within the limits of the measuring capabilities of the meter.

The switch is then shifted from the switch point connecting to T2 to the switchpoint connecting to T4. When the switch connects to T2, the standard resistance Rs is connected into the ammeter circuit, while when it is shifted to T4, the unknown resistance Rx is connected in the circuit. Readings of the ammeter or milliammeter are taken under both conditions whence the unknown resistance is obtained by using the following formula:

$$Rx = \left(\frac{(Rs + Rm)}{} \times \frac{Is}{Ix}\right) - Rm$$

Where Rx is the unknown resistor, Rs is the standard or known resistor, Rm is the meter resitance. *Is* is the current reading with the standard resistor connected in the circuit and Ix is the current reading with the unknown resistance connected in the circuit.

The most accurate readings are obtained when both resistances are approximately equal, that is, when the current readings are approximately the same.

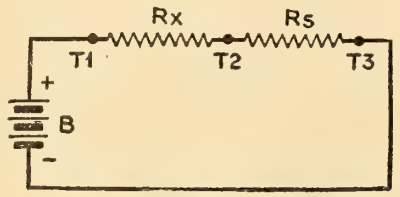


Figure 3

Another simple method of obtaining the resistance value of a resistor when a voltmeter and a standard resistance of known value is available makes use of the circuit shown in Fig. 3.

In this method the standard resistor Rs is connected in series with the unknown resistor Rx and the series combination of resistors is connected across a battery. A high resistance voltmeter is used to measure the voltage drop first across the known resistor, Rs, and then across the unknown resistor Rx.

The value of the unknown resistor is found by using the following formula:

$$Rx = \frac{Ex \times Rs}{Es}$$

in which Rx is the unknown resistance, Rs is the known standard resistance, Ex is the voltage across the unknown resistence and Es is the voltage across the known standard resistance.

This method should be used only with resistances whose values are low in proportion to the resistance of the volmeter, since otherwise the current drawn by the meter resistance will introduce an appreciable error.

This error may be eliminated by using a variable standard resistor which can be varied so as to be made equal to the unknown resistance. The variable resistance is equal to the unknown resistance when the voltage across both resistors is the same. In such cases the current drawn by the voltmeter does not affect the accuracy of the measurements, since the voltmeter will affect both readings to the same extent so that the error cancels out.

Council Branch in England

Laurence Jones, Secretary of the Projection Advisory Council, sailed for Europe on May 10th for his first visit in 12 years to his home in England. While abroad, Mr. Jones will act as special representative of the Council, particularly with a view to establishing a branch in Great Britain and laying out the plan of organization and procedure.

* Acrovox Wireless Corp.

Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

IT is customary with recent Western Electric Power amplifiers to remove one of the amplifier or rectifier tubes and observe the plate current reading and then after replacing this tube, remove the remaining tube and observe the plate current reading. It is advisable not to leave these tubes out of their sockets, only long enough to observe their values, as it is likely to cause a voltage surge on the remaining tube that may break down the secondary of the power transformer or the condensers.

In response to a question—what causes hum in both Movietone and Vitaphone reproduction?—it is quite evident that if hum is encountered with both Movietone and Vitaphone subjects the trouble is in the power amplifiers. Hum can often be traced to defective or shorted tubes, either in the stages preceding the last stage or in the last stage itself. On many occasions I have found unbalanced rectifier tubes, which caused a very bad hum. Worn out tubes (low emission), frequently cause squealing and howling.

If popping or crackling noises are perceptible at high volume levels, this trouble can often be located in the base of one of the 211-E vacuum tubes in the 43-A amplifier or one of the 205-D vacuum tubes in the 42-A amplifier.

The first point to remember is to check the tubes and take nothing for granted. Excessive hum can be caused by shorted bypass condensers, open secondary of input transformers and bias resistors, shorted filter chokes and filter condensers, although the latter condition will manifest itself in over-heating of the rectifier tubes and power transformer. Great care must be exercised that the input wiring to the amplifiers is well shielded from all A. C. wiring. Occasional bad hum can sometimes be traced to the fields from adjacent electrical equipment, such as mercury arc rectifiers, rotary converters, motor generator sets and small motors.

The A. C. circuit, which feeds the power amplifiers and rectifiers, should always be run independently and should never be on the same circuit with any other electrical appliance. The best method to find out definitely if the hum is caused by some other electrical appliance is to turn on the amplifiers, with all the other electrical equipment turned off. If you find that the hum is not in the amplifiers turn on each electrical appliance individually until you find the one which is causing the frequency hum during the time the amplifiers are in operation.

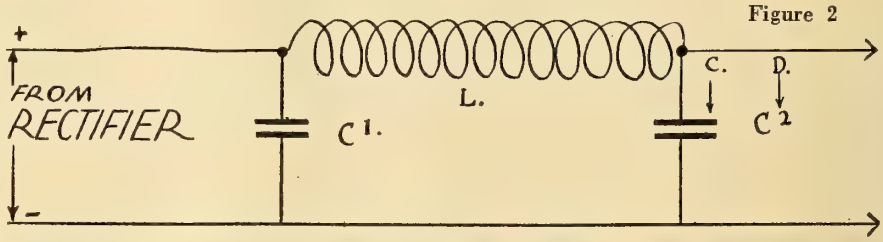


Figure 2

Filter Systems

Another question was received asking to explain the action of a condenser and choke coil in a filter circuit, such as we have in the recent Western Electric and RCA sound equipment amplifiers. A filter circuit consisting of a reactance (choke coil) and condenser is illustrated in Fig. 1. Directly above the iron core reactor L there is illustrated a pulsating current, as shown by the undulations of fluctuations in line drawn from R to S. For a simple explanation, these pulsations may either be due to a ripple in the direct current output of a D. C. generator, or may result from the rectification of an alternating to a direct current. The pulsations or ripples in direct current from a generator are sometimes called commutation ripples, and in most cases are comparatively slight in a well-designed D. C. generator, one made especially for supplying plate energy to power tubes.

The filter system in this case need not be so large—that is, the choke coils may be wound with less turns of wire and on a small laminated iron core. However, in the case of alternating current, a step-up transformer is used to produce any desired A. C. voltage and this alternating current is converted into a direct current by the use of a rectifier, such as in the 42-A and 43-A amplifiers.

The rectifiers in these amplifiers will deliver a direct current as widely fluctuating in magnitude as the current is any one alternation of the A. C. cycle. The output of the rectifier is insufficient insofar as it does not provide a steady D. C. flow suitable for plate excitation. The filter system required for smoothing out the fluctuations in direct current following the action of the rectifier in changing alternating current to direct current, must in this case be quite large.

The inductance of the choke coils and capacity of the condensers must be large enough to reduce the amount of the fluctuating direct current to prevent any modulation effects which would be reproduced and heard in the output as a hum or purring sound. The purpose of the filter system, Fig. 1, is to smooth out these pulsations and provide a steady, non-fluctuating direct current suitable for energizing the plates of vacuum tubes. The filter system, shown in Fig. 1, is only part of the complete rectifier apparatus. The two elements shown, reactor and condenser, are used in this case merely to describe their combined action.

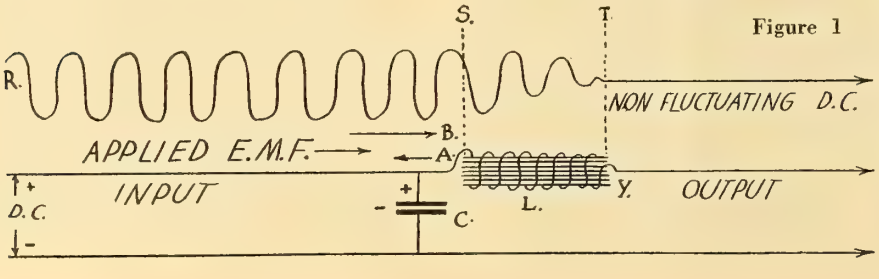
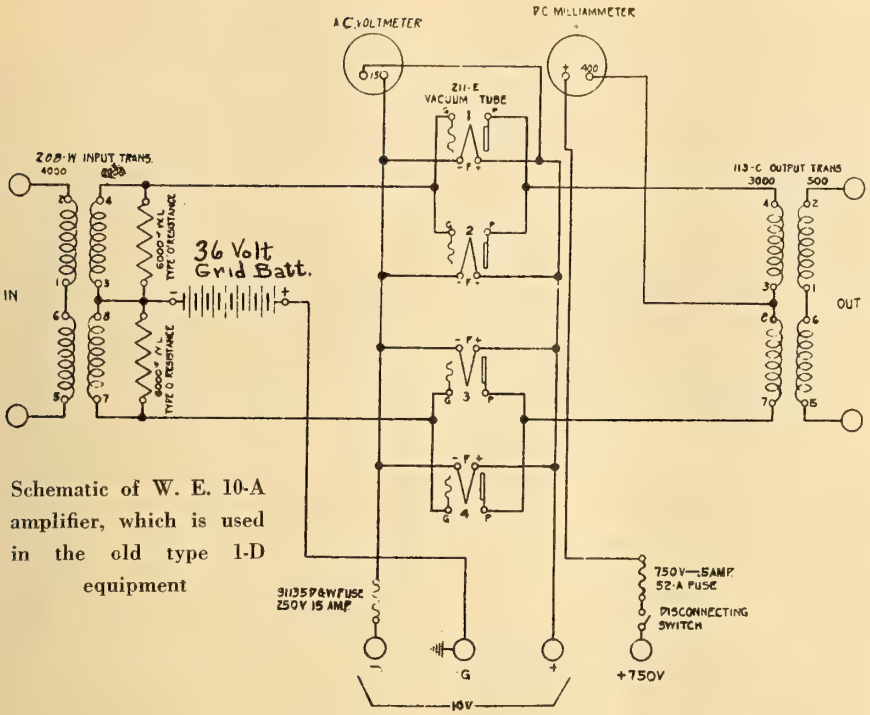


Figure 1

Action of Elements

The action is as follows: When current in the D. C. line increases, the magnetic flux in the iron core of choke coil L increases, building up in the coil a high reactance voltage because of the large inductance of the coil. Because its inductance is in the vicinity of 50 henrys it will tend to oppose this current rise in the circuit, due to the high counter voltage induced in direction of Arrow A. This counter voltage is applied to condenser C indicated by Arrow D, because C is connected to L, as shown.

The condenser receives this charge and would ordinarily hold it, if no further change of voltage occurred in the line. But the current in the line is fluctuating, and during one of the D. C. pulsations the self inductance of L will cause an e. m. f. to be generated in the direction of Arrow



Schematic of W. E. 10-A amplifier, which is used in the old type 1-D equipment

B. This is the action of all inductances, for they tend to prevent any current changes in the circuit. When the voltage in the line decreases, the condenser will release part of the charge it received when the current increases in the line. Therefore, the condenser supplies a new voltage to the circuit. This compensates for the decrease in the line voltage.

The discharge of the condenser, which is shown by the Arrow E, is clearly in the same direction and aiding the line or applied e. m. f. Since the condenser tends to maintain a constant voltage in the line, current will flow uniformly through the circuit. The condenser functions somewhat like a reservoir in storing up an electrical pressure. It receives a charge when the line voltage increases and gives up some of its charge when the line voltage decreases, always trying to equalize the changes and thus maintain a steady flow current in the circuit.

Although this explanation is fundamental in regard to the filtering action, it is not complete, inasmuch as it has been found, in practice, that when only one condenser and one choke coil are used, they will not always completely filter out or smooth out pulsations caused by rectified alternating current. You will notice that in the line from S to T that the amplitude of the pulsations is lowered considerably through the action of the reactor in combination with the condenser, and from T to U, it is noticeable that a reasonably steady direct current is supplied to the output circuit.

Fig. 2 illustrates two condensers C1 and C2 each connnected to either side of the filter reactor L. The action of this system is similar to the one just mentioned. By the addition of condenser C2 the process of smoothing out the pulsations is more complete, because condenser C2 will charge and discharge as shown by Arrows C and D provided there is a slight ripple or fluctuation of the direct current flowing from the reactor, which sets up an e. m. f. as shown by Arrows A and B.

The function of the filter system is to smooth out these pulsations and to deliver a substantially unidirectional steady direct current to the plate circuit. A filter system may be arranged to consist of one or two filter reactors or choke coils, and one or more condensers of suitable capacitance and dielectric strength.

10-A Amplifier

WESTERN ELECTRIC manufactures many amplifiers. However, the largest power amplifier in use today with sound equipments is the 10-A amplifier, which is used with ERPI old-type equipments. This amplifier is entirely A. C. operated, with the exception of the grid circuit which receives its potential of 36 volts from eight (8) No. 703 Eveready batteries.

The output of the 8-B amplifier is connected to the input of the 10-A amplifier. This amplifier has a gain of 20.6 decibels and has an output of 21.4 watts. It employs four (4), 211-E vacuum tubes and is the push-pull type with the filaments connected in parallel. The filaments of these tubes operate at 10 volts A. C., and the plate potential is 750 volts, which is supplied by a rectifier unit known as the 6,000-A rectifier.

The 10-A is equipped with its own filament voltmeter and its own milliammeter for plate current reading. The amplifier is transformer coupled, with an input impedance of 4,000 ohms and an output of 500 ohms.

As you will note on the accompanying schematic of the 10-A, there is no way of controlling the gain. The tube filament voltage can be increased or decreased by a rheostat which is mounted on the 521 filament supply panel. The value of the plate current should be between 175 and 250 milliamperes. The rear of this amplifier is provided with a cover which, when removed, opens a switch and automatically opens the 750-volt plate circuit. The filament and plate circuits are fused. A 15-amp. fuse protects the A. C. filament circuit and a .5 amp. fuse protects the 750-volt plate circuit. The 10-A amplifier circuit is very simple. The 211-E vacuum tubes in the 10-A amplifier should be well balanced.

Method of Testing

The following method should be used for testing. Place the tubes to be tested in the sockets of the 10-A amplifier and adjust the voltages and currents of the system to normal values. Reduce the filament voltage to the 10-A amplifier tubes to 5 volts. Remove one tube from each side of the amplifier and adjust the filament voltage of the amplifier to 10 volts.

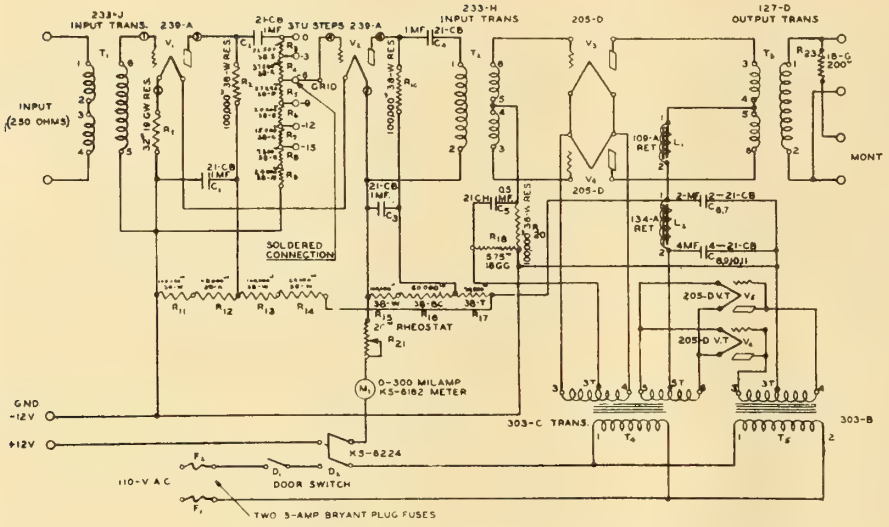
Remove one tube from the amplifier and note the plate current reading of the remaining tube, which should be within the limits of from 40 to 100 milliamperes. Replace the tube just removed and remove the tube just tested and observe the plate current value. The two tubes should test within 10 milliamperes of each other.

Remove the two tubes just tested and insert the first two tubes originally removed. Test these two tubes, as outlined for the first two. Care should be taken to turn off the plate supply to the tubes when removing or replacing them in a socket, otherwise, there is danger of causing a high voltage flash-over. It is imperative to warm up cold tubes, before making a test.

46-A Amplifier

THE Western Electric 46-A amplifier is used with the 3-S sound installations and is the smallest composite unit W. E. manufactures for theatre sound installations at the present time. This amplifier has given very little trouble in comparison with other types of W. E. amplifiers in use. This amplifier uses 110 volts A. C. supply and also 12 volts of battery power. The input is 250 ohms. The first and second stages employ two 239-A vacuum tubes with a resistance coupling between them. The gain control is connected between the secondary of the input transformer and the grid of the second tube and can be adjusted in steps of 3 s.c.

The first and second 239-A tube filaments receive their supply from



Schematic of W. E. 46-A amplifier which is used with 3-S system, usually in theatres with 1,000 seats or less

a 12-volt battery. A rheostat is connected in the filament circuit so that the proper value can be obtained. The 239-A tubes have their filaments connected in series: if the filament of one tube burns out, the other tube will not function.

The third stage employs two 205-D tubes connected in push-pull. A transformer couples the second and third stage. The two 205-D tubes in the third stage have their filaments connected in parallel. The primaries of transformers T-4 and T-5 are parallel on a 110-volt A. C. supply. Transformer T-4 feeds current into the filament circuit of the rectifying and amplifying tubes in the third stage. Transformer T-5 supplies plate potential to all amplifying stages in the 46-A amplifier and also the plate potential for the two 205-D rectifier tubes.

Full-Wave Rectifier

The 46-A W. E. amplifier equipment includes a full-wave rectifier. A full-wave rectifier is a rectifier which rectifies both alternations or both halves of the alternating current. Both the positive impulse and the negative impulse of the alternaing current are passed through a full-wave rectifier. The resulting pulsating direct current has as many rises and falls of currents as the alternating current has alternations, this being double the number of cycles.

The following is a brief explanation of the 46-A amplifier full-wave rectifier. The direction of current flow from the rectifying tubes V-5 and V-6 is from plates to filament into the secondary of transformer T-4, and out through center tap of the secondary to the retardation coil L-2, and through system of condensers C6, 7, 8, 9, 10, 11.

The retardation coil and condensers form a complete filter system, which serves to by-pass or filter out the alternating component of the pulsating rectified current, which comes from the rectifying tubes V-5 and V-6, so that true direct current is obtained by smoothing out or removing the A. C. ripple from the current going to the amplifier tubes V-3 and V-4. From retardation coil L-2 and condensers, the current flows into retardation coil L-1. Retardation coil L-1 is used to prevent the amplifier current fluctuations from being shunted through the rectifying circuit.

On many occasions amplifier tubes become unbalanced and it is found that retardation coil L-1 preserves the push-pull action of the circuit. From retardation coil L-1 the current flows to the secondary of transformer T-3 and to the plates of amplifier tubes V-3 and V-4 and out through the filaments into the secondary of transformer T-4 and out through the center tap, across resistance R-18 and back to the center tap of transformer T-5.

Across R-18 there is a voltage drop that impresses a negative bias on the grids of tubes V-3 and V-4. Resistance R-20 and condenser C-5 is used to remove the remaining ripple and unrectified alternating current from the negative grid voltage of tubes V-3 and V-4. The grid bias for the 239-A tubes is obtained by a voltage drop across resistance R-1. The plate potential for the first 239-A vacuum tube is taken between R-12 and R-13. The second 239-A tube (V-2), the plate potential is taken between R-16 and R-17. The output is through the transformer T-3 and to the receiver circuits. This amplifier has an output of 2.4 watts.

Condensers

When a condenser breaks down, due to an overload, it is very perceptible as the reading on the plate current meter will fall below the red limit. Take the 43-A amplifier for instance. Two groups of condensers are used with this amplifier. They are connected in parallel. As indicated on the W. E. schematic drawing on the cover of the 43-A amplifier, you will notice that the first group contains condensers from C-2 to C-10, and the second group contains condensers from C-11 to C-19. These condensers are accessible by removing the front cover of the amplifier.

If the plates of the rectifier tubes get excessively hot, this is another indication of a defective condenser. The troubles experienced with fixed condensers are open circuits and short circuits, usually the latter. This is caused by overloading the condenser with excessive voltage, which punctures the insulation and provides a path for current across the plates. Turn off power to amplifier before testing for a defective condenser. You will notice that all connections are soldered to the condenser terminals on the 43-A amplifier.

Keep in mind that two groups of condensers are in use, first unsolder connection connected to the lower terminal of C-2. This lead comes from behind the panel. After unsoldering connection on condenser C-2, turn amplifier starting switch to plate; if the meter reading is normal, the defective condenser is in this group. Again turn off power to amplifier before continuing operation and find the defective condenser. Restore the connection to condenser terminal C-2; unsolder connection between C-2 and C-3, and again turn on starting switch to plate. If the meter reading is still normal, it indicates that C-2 condenser is good and that the trouble is between C-3 and C-10.

Continue testing in this manner until you locate the shorted condenser, which will cause the meter reading to fall. If you find at first by unsoldering lower terminal of C-2 that it does not bring the meter back to normal reading, it shows that defective condenser is in the second group C-11 to C-19. Restore the connection on C-2 and test the second group of condensers for a defective condenser as outlined for testing the first group of condensers.

After you have found the shorted condenser, disconnect it from circuit and continue operation and immediately order another for replacement. I have advised before that condensers should be disconnected completely from the circuit before testing, so that there will be no shunt path around them, which would give a faulty test. Before testing the condenser for open circuits and short circuits, discharge by holding a wire or a piece of metal across its two terminals. This will prevent an erratic test caused by a residual charge.

A headphone tester and a C-battery connected in series should be used for testing condensers. Touch the condenser terminals with the headphone tips of the tester and C-battery connected in series. There will be a click resulting from the sudden formation of a charge on the condenser plates and the accompanying rush of current through the head-

phones. Tap one of the testing tips to the condenser terminal several times. Sharp clicks should not be heard after the first and no click should be heard when the testing tip is removed from the terminal. A double click obtained when the tip is applied and when it is removed indicates a short circuit.

Common Troubles

A condenser may be faulty even though it does not show a direct short circuit. Moisture in the insulation may cause a slow leakage and this makes the condenser worthless for use in an amplifier. First discharge the condenser completely and lay it on a piece of glass, mica, bakelite, or other insulating material. Charge it by holding the two leads from a C-battery or B-battery to its terminals for a moment.

After waiting a few minutes touch both terminals with the testing tips of a headset, without any battery in series. If a strong click is heard, the condenser has retained the charge, but if a weak click is heard, or none at all, the condenser is leaky. The strength of the click of a condenser depends to a great extent on its size. When testing a condenser, care must be taken not to touch the terminals of the condenser or the bare tester tips with the fingers, as this permits a loss through the body and consequently results in a faulty test.

This Problem of Projecting Three Films on One Machine

By M. H. GOLDBERG
Projectionist, Biltmore Theatre, Chicago

WHENEVER two or more projectionists get together one question comes up early in the conversation and usually receives attention for the rest of the night—how to get equal results from three kinds of film in one kind of projecting machine? It is inevitable that this question will engender plenty of discussion at the forthcoming I. A. Convention, and the writer offers this statement as his contribution to the sum of information on the subject.

The number of ingenious devices invented by projectionists to solve this problem reflects great credit on the craft. Greater credit is due because of the conditions that have prevailed during the last two years. We have been forced to adapt ourselves almost overnight to a set of radically new and different circumstances the while carrying on successful performances.

It is one thing for a highly trained scientist to produce satisfactory results after years in a fully-equipped laboratory. It is something very different for a man after only a few weeks of study to produce equal results from totally new and strange equipment in a theatre that has no endowment except the "two-bit" pieces of a few hundred highly critical patrons!

Many Devices Have Failed

Certain fundamental principles govern projection, and it is remarkable that they are so often lost to view. This is proved by the nature of many inventions offered to solve our problem. Along a shelf in almost any projection room one can find a row of devices for adapting the projection machine to the various films. These devices have been discarded because they failed to live up to the claims made for them.

Complexity is the chief fault of most of these devices. The writer has examined most of them. They were studded with handles, clamps, levers, buttons, knobs and screws. They were filled with mirrors, prisms, and multiple lenses. To attach them called for practical rebuilding of the projection machine. The projectionist who used them had to be a combination of Houdini and Thurston. Some of these devices gave wonderful results when properly adjusted, but proper adjustment often called for several minutes of experiment. If the adjustment was not correct, the screen was covered with fuzz. It was plain that the inventors of these devices had gone the long way around. The fundamental simplicity of light had been ignored or forgotten.

The very first thing an illumination engineer learns in college is that light moves in a straight line, and the less that line is interfered with, the better for the light. Every time a ray of light is reflected or refracted it loses some of its brilliance. When a beam of light is focused and re-focused by a series of lenses, the difficulty of getting an accurate final focus is many times increased. Projectionists cannot afford to ignore the truth that *simplicity* must be the first requisite of any device for controlling light.

Duty to Employer and Patrons

It is our professional duty to our employers to master the principles of these devices and judge them by the way they agree with the fundamental law of simplicity. It is rare that a theatre owner is also a projectionist. If he has been a projectionist, he may make an intelligent choice among the devices on the market. But more often he is a business man, not a technician. It is our part, therefore, to furnish him with the scientific knowledge that will prevent him from wasting money on devices that by their very nature are impractical. We should be selfish in this matter, too, and object to being supplied with equipment that requires us to lower the quality of our performances. After all, we are employed to deliver a clean-cut, continuous picture with accurate sound synchronization, and anything that fails to help us do that, or interferes with our doing so, should be fought, whether for our own working comfort or for the profits out of which we are paid.

Present Lens Satisfactory

What is wrong with the lens now in use on our present projecting machines? The manufacturer chose it to fit the machine. It gives satisfactory projection—why not keep on using it? All that is required is a lens mount that will also accommodate an aperture plate capable of being shifted from the center line of one film to the center line of another.

In the author's personal experience a device of this nature has given complete satisfaction over several months of daily use, and he would be glad to see his colleagues receiving equal satisfaction. It involved only the purchase of a lens mount in which was placed the lens then in use on the projection machine, and a fitting for the mount, which contained an aperture plate that shifted sidewise at the touch of a little lever. The entire cost for two machines was not as much as was asked for equipping one machine with an elaborate device that failed in practical use.

The device that succeeded is known as the Unilens mount and it is made by the Golde Manufacturing Co. at 2013 Le Moyne street, Chicago. It perfectly follows the principle of simplicity, and it is extremely easy to use, as all the adjustments and the focus are fixed. A light push with one finger moves two little levers about a quarter of an inch, and shifts the center line of the aperture plate to coincide with the center line of the different films. The changeover takes about one-twentieth of a second, too fast for the eye to catch, so that no change is apparent to the audience, as the image on the screen does not shift at all. So speedy is the change that all three kinds of film may be run from one reel, and a projectionist who knows his cues can give a straightaway run without once betraying the change from one film to another.

Sees Unilens as Standard

It is the writer's opinion that the Unilens method will eventually become the standard method of handling all films in one projection machine, as long as 35 mm. film is in use. Of course none of us can foretell the problems that will arise with the use of wide film. But it is certain that there will always be two kinds of sound film, whatever the width may become, so that some sort of changeover device will henceforth be a part of every projector, and the Unilens device, by its simplicity and low cost,

seems the one most certain to survive.

The fact that it is scaled to fit the new standard ground glass markings of the S. M. P. E. is bound to be another factor in its survival. It will suit all forthcoming releases, so there is no danger of its soon becoming obsolete and proving a waste of money to its owner. This fact was a weighty consideration with the author before installing the Unilens on the projecting machines he operates.

The writer's enthusiasm for the adoption of the simplest and least troublesome instruments will be shared by his fellow-projectionists who have gone through the last two years of learning how to manage complicated gadgets. While the laboratory sharps are spending months and millions inventing tangles of wire and gears for us to master, we should all stick the closer to the simple fundamentals of our trade. There is real danger that in trying to become scientists ourselves, we may lose sight of the one thing that makes and holds our jobs for us—the show, and a good one, must go on!

Gleaned From the Mail Bag

RECENT comment in these columns on the carelessness with which film is handled by both exchangemen and projectionists has been productive of a number of highly interesting reactions. One of these is the awakening of many projectionists to the fact that they are not obliged to hack and patch a badly damaged print so that they may at least run it through their projectors. Projectionists whose responsibility it is to put on a good show have every right to be insistent that the prints with which they are served be in first-class shape. Exchanges all over the country have been made to feel the pressure now being brought to bear by projectionists who no longer consent to run poor film.

That this condition represents very nearly an ideal situation is reflected by the increasing vigilance on the part of exchange managers in seeing that neither their own employees nor projectionists take any undue liberties with prints.

The following letter suggests a rather pessimistic outlook, but immediately thereafter follows a statement from one of the larger producers which gives assurance that the vigorous follow-up given all film complaints by MOTION PICTURE PROJECTIONIST will eventually eliminate a major portion of print ills.

On 'Track' Prints

"*Editor*, M. P. PROJECTIONIST.

Sir:—As a subscriber to your paper I have noted comments therein lately on the way film companies have been sending out track prints to be used with disc equipment. As a result of this practice the projectionist will black patch the film and use only the care necessary in preparing the film for his own disc run—forgetting entirely the man who follows him up with sound film equipment.

"In my case the situation is a bit different for I have a disc outfit. Film companies send me sound film prints which, of course, have been cut in numerous places and are hopelessly out of synchronism. Only the other day I received such a print from Universal. My first impulse was to write to the company; but on second thought I decided that my efforts would probably net me but a letter in which I would be told to take care of my projection equipment and they (Universal) would take care of their film.

"It is hard to say just now what the outcome of this loose practice will be, but one is safe in saying that the answer, whatever form it takes, will be 'waste'."

A more cheerful note is sounded in the following communication, the answer to a letter from this publication inquiring as to the reason for the omission of footage numbers from prints. The letter follows:—

PATHE EXCHANGE, INC.

EXECUTIVE OFFICES
35 WEST 45TH STREET
NEW YORK

"*Editor*, M. P. PROJECTIONIST.

"Sir:—This late reply to your letter of April 12th is because of the fact that the writer has been out of town for several weeks and your letter was held over for my return.

"Originally Pathé issued only sound track prints, and it is true that footage numbers were not used at that time. Later when it was decided to issue a disc print of our releases, in addition to the track print, we found it was absolutely necessary to have each and every print carry footage numbers on the side of the film. Accordingly we arranged to place the footage numbers on the negative, and every positive print taken from this negative necessarily carried these footage numbers.

Interchangeable Prints

"Later we experimented with the use of interchangeable prints. In other words, we used the same print for both disc and track equipped houses. After this practice was in vogue for a few months we had considerable trouble because a disc equipped house would insert blank leader in the film, and later, when this same print was shipped to a track equipped house the operator would remove this blank leader. When this same print next went to a disc equipped house it would be out of synchronization, and naturally the exhibitor had reason to complain against the use of interchangeable prints.

"Therefore, we discontinued the use of these interchangeable prints some months ago, and now use a separate track print for a track equipped house and a special disc print for disc equipped houses. In both cases footage numbers are carried on the prints.

"Thank you for calling this matter to our attention and I assure you that we welcome any constructive criticism as it enables us to give the exhibitor the service to which he is entitled.

"Yours very truly,
E. W. BALLENTINE,
MANAGER OF EXCHANGE OPERATIONS."

The last paragraph of Mr. Ballentine's letter is indeed cheering, and we all should be appreciative of his desire to be helpful. The Service Department of MOTION PICTURE PROJECTIONIST is at the service of all subscribers, and all poor prints may be reported thereto. Action similar to that cited above will be promptly taken and vigorously followed-up. When reporting poor prints please do not fail to mention the title, exchange, and date upon which you received the print. Details as to print condition are also requested.

Care of Batteries

It is essential that storage batteries receive attention at regular intervals. The most important item in the care of a battery is that of adding pure distilled water. A sufficient quantity of water should be placed in each cell to bring the surface of the liquid from one-quarter to one-half inch above the tops of the plates. Some have endeavored to set regular intervals for adding water to battery cells, but it is almost impossible, as every theatre is operating under different conditions.

Distilled Water

Distilled water for batteries should be kept in a glass bottle and not in a metal can. Care should be used when testing not to spill *electrolyte* on top of the battery, as it will cause corrosion at the terminals and partial short-circuiting of the cells, which will cause a hissing and frying noise in the reproduction. Constant charging and discharging and also room temperature causes some of the water contained in the electrolyte to evaporate, and if the lost water is not replaced, the level of the electrolyte will drop below the level of the plates, which may injure them.

When inspecting the battery to see whether or not it contains enough electrolyte, never hold a lighted match over the vent holes of the cells.

Report on S. M. P. E. Spring Meeting

By JAMES J. FINN

THE Spring Meeting of the S. M. P. E. held at Washington, D. C., May 5 to 9, was one of the most successful conventions ever sponsored by this organization—successful in that it attracted a record number of the leading scientific minds in the motion picture industry and allied fields, who contributed to the forward march of the motion picture an amazing amount of data in which past experiences were reviewed and new paths of endeavor charted. All too short was the time alloted for the reading of the many papers listed by the Papers Committee, and it is to be regretted that several committee reports and discussions on some of the papers presented were necessarily curtailed. On the whole, however, the sessions were admirably presided over by President J. I. Crabtree who, with the assistance of J. H. Kurlander, secretary, did a fine piece of work in handling the presentation of papers and conducting the business of the society.

To set down here even a small fraction of the many-sided aspects of the meeting would require a dozen pages of this publication, thus, this report will be confined to those subjects which are considered as being of particular interest to projectionists. Incidentally, the meeting was attended by more than a score of projectionists who having gone and heard are presumably now reporting to their brother craftsmen the very latest developments in the field.

Projection Committee Report

As was to be expected, sound pictures provided the topic for a majority of the papers read, although there were sprinkled throughout the sessions pertinent references to projection matters, details of which are appended hereto. A disappointing feature of the meeting was the vacuity of the report by the Projection Committee. In a field where developments are taking place daily, and where there lie so many opportunities for improvement in equipment and technique, there should be ample material on which to base a real contribution to S. M. P. E. records. Theatre presentation is regarded by all engineers as the key to the success of the entire motion picture industry, and it is to be regretted that there is not more activity among the various agencies commissioned to watch developments in this field. Much interest will be manifested in the Projection Committee report at the ensuing Fall Meeting of the Society, and it is not unlikely that definite steps will be taken to insure a comprehensive presentation on the subject at that time.

One recommendation of the Projection Committee which is bound to attract much attention is the suggestion that the present method of controlling sound volume from the projection room be displaced by remote control of volume from the auditorium. In his report, L. M. Townsend, chairman of the committee, stated that a recent survey demonstrated conclusively that far better results may be had by auditorium volume control than by control from the projection room. Soundproof rooms, said the report, militate against any intelligent degree of volume control by the projectionist.

Color Productions

Pervading the meeting in informal discussions was the impression that color in motion pictures will shortly have to be the beneficiary of some radical changes in technique else it will lose its initial advantage which has been gained, according to a consensus of opinion, by virtue of its novelty rather than as a result of any particular technical excellence. Advances are promised in this art, but as yet there is an absence of any data on which such promises might be based.

Present color productions are not at all satisfactory, if one is to be guided by the discussions at Washington, and there seems to be general agreement with the view that there should be a curtailment on the general use of color until such time as more satisfactory results can be obtained. Color sequences in motion pictures are not regarded very highly as entertainment value by several eminent motion picture executives, according to information conveyed to this writer. The sudden change from ordinary black-and-white to color and back again to the former has anything but a soothing effect on the average theatregoer. The relative merits of black-and-white and colored pictures were discussed in previous issues of this publication.

Wide Film Standards

Wide film came in for extensive discussion at the meeting. A committee headed by Dr. A. C. Hardy of the Massachusetts Institute of Technology has been busied during the past few months in an effort to reach some satisfactory basis of standardization. Numerous committee meetings, conferences with producer representatives, and discussions with leading workers in the art failed to produce the answer to this much mooted question of a standard wide film size. Sixty-five, 68 and 70 millimeters have been championed by various groups and individuals, but it is as yet unknown just which size will win the choice.

Discussion is prevalent, in engineering circles, however, that 70 millimeters, the present size of the Grandeur system, will be decided upon as standard. The economic factor of the problem, it is said, will have as important consideration in the last analysis as anything else. This report has gained considerable credence of late because of the fact that General Theatres Equipment Co. is reported to have more than two million dollars invested in equipment designed for 70 mm. use, adjustment of which for any other size is held to be impracticable. Thus, 70 mm. would appear to have the inside track at this writing.

Film vs. Disc Sound

Another highlight of the meeting was the verbal contest waged between supporters of sound-on-disc and those favoring sound-on-film. An imposing array of statistics was presented by the proponents of each system, but a careful reading of all this data would not settle with finality this vexing problem. Here again the economic factor intruded, with the supporters of sound-on-film asserting that the mortality rate on discs was such as to definitely relegate the latter to second place—irrespective of its technical merits. Those in the disc camp replied that the extra care in handling was more than justified by the superior results obtained with this method.

These arguments have a familiar sound to those who have followed closely developments in the sound field, and it may be safely said that these recent discussions have added but little to the sum total of knowledge on the subject. Cost tally sheets undoubtedly will provide the answer to this problem.

Film Reel Sizes

Double reels for projection purposes came in for their share of attention. The matter was settled—to the distributors' satisfaction, at least—by the citation of the following "facts":

Some of the large operating chains have banned double reels, thus the practice should be discouraged by *everyone* in the industry. Reel assemblies are changed in many cases; there is a loss of important film "where the projectionist fails to return it to the exchange"; there are mixups in the consecutive arrangement of the reels in following shows "where the projectionist has erred in affixing the part titles on their respective reels and makes it most difficult to retain the reels in proper

condition to be converted into a synchronized disc print. In addition, when film is scratched or otherwise damaged by passing through a projector that is so damaging it, the amount of damage is usually in proportion to the amount of film footage mounted on the reel being projected."

The foregoing quoted statement is not, to our way of thinking, based on fact. As an argument for the continuation of single reels, it is great; but it affects in no way the validity of the facts brought out in recent discussions of film reel sizes in these columns in the February, March and April issues of this year. Further, copies of the above discussion were widely distributed among exchangemen, projectionists, and producer representatives, yet not a single reply in support of single reels was forthcoming to combat the very excellent reasons submitted by those in favor of double reels. But—more on this anon.

Life of Prints

Two hundred runs was set as the figure for use of a sound film before it would be put in questionable condition so far as further screenings were concerned. More on this topic is as follows, for which the projectionist may take a bow—or rather, a few bows:

"A fair average of the number of times a sound-track print could be run before the normal wear and tear on it would put it in this questionable condition so far as further screenings are concerned could be placed at 200 times.

"Distributors who use the utmost care in their exchange maintenance of film will find that fully 75 per cent of the film that is returned to them from the field, for final disposition, will be in good physical condition so far as sprocket perforations are concerned. This is due to a combination of—improved conditions of projection equipment, a better knowledge of this equipment and its operation by the projectionist; a far greater regard the projectionist has for film conditions; increased bookings of multiple date screenings and fewer bookings of the one day runs; a more organized inspection department in the exchange backed by the desire of the exchange manager to have this department functioning as nearly 100 per cent efficiently as is possible."

Television Developments

Contributions to the television art were made by Dr. V. Zworykin of the Radio-Victor Laboratory in Camden, N. J., and by C. Francis Jenkins, noted worker in the field. Dr. Zworykin described his new cathode ray system, which differs radically from the conventional scanning-disc method. A picture 5 by 6 inches, very well illuminated, has been secured by Dr. Zworykin with his new ray system. C. Francis Jenkins, reported to be of the opinion that commercial television on a large scale is at least five years away, contented himself with the announcement of the establishment of a new laboratory for his research and the statement that radio movies for the home are but a matter of a few weeks. Conspicuously absent was the information as to the source of programs for these home radio movies.

In talks with this writer, Dr. Zworykin said that television is still in the laboratory and need cause no great concern in the amusement field for several years to come, unless . . . unless there is an unexpected epoch-making contribution to the art. It is interesting to note that the trend in television work at present is all toward the continuous movement (non-intermittent) projector, a necessity to insure constant film speed in the scanning operation.

Discussion on Speakers

The reading by L. Malter of RCA Photophone, Inc., of a paper in which he reached the conclusion that the directional baffle type loudspeaker was definitely superior to the horn type, precipitated an interesting discussion. Malter stated that tests had demonstrated the superiority of the directional baffle type in frequency range and uniformity of response, although both were the same in radiation distribution characteristics and input power capacity. He conceded the superiority of the horn type speaker in the matter of efficiency.

Malter's remarks introduced a discussion which ran for slightly more than an hour after the paper had ended. This discussion developed some highly interesting data with respect to the advantages of both types of speakers, but it cannot be said that either side proved its case. President Crabtree closed the discussion by remarking that both types still have a long way to go to reach perfection.

Changes in Electrical Code

Radical changes in the National Electrical Code were forecast by J. R. Manheimer of the E-J Electric Installation Co. of New York, as a result of the confusion existing among electrical, city and fire inspectors in the absence of definite requirements for sound picture installations. The use of theatre dimmers with a three-wire system of wiring, as at present, was declared by Manheimer to be slated for the blacklist on the new Code. Progress in the sound picture art is held to be responsible for the urgent necessity for drastic changes in the Code.

The meeting offered a wealth of information for workers in all branches of the motion picture industry, the foregoing having been set down here in a somewhat detailed form because of the interest of projectionists in these particular subjects. At a later date it is planned to abstract those papers presented at the meeting which have the greatest appeal to projectionists. Abstracts of some of the papers are appended hereto.

Comparative Study of Sound on Disc and on Film

Porter H. Evans, Vitaphone Corp.

The paper discusses the relative merits of sound-on-disc and sound-on-film from all angles. The advantages and disadvantages of the two methods are considered from a standpoint of sound quality, operation and cost, and each factor is considered practically, as well as theoretically, and the points at which the theoretical advantages are not realized in practice are pointed out. The factors are also discussed from the producers', distributors', and exhibitors' standpoint.

It is maintained that sound quality in the theatre is the differentiating factor between present successes and previous failures. Due to the inherent lack of inertia in the film, causing speed variation or flutter, and the necessity of using more complicated and delicate apparatus in film reproduction, it is stated that better results are obtained at the present time in the theatre using disc.

Improved Film Reproduction

It is pointed out that the obvious advantages from an operating standpoint of sound-on-film have enhanced, and are stimulating the development of this method, that marked improvements have been made so far, that the weak spots are gradually being discovered and eliminated and that at some future date we may expect the film to produce equal or superior results to disc.

Compounded Geneva Pull-Down for M. P. Apparatus

F. Tuttle, Kodak Research Labs.

Practically any mechanism used for moving film intermittently in motion picture apparatus can be run at a speed considerably higher than normal operating speed without damaging the film. Since the time occupied for the actual movement of the film is so much time lost from the useful part of the shutter cycle, it would be advantageous, then, if the shutter cycle could be reapportioned, allowing more time in the useful part of the cycle by speeding up within the permissible limits the movement of the film.

By combining two Genevas in such a way that the driving pin of the second Geneva is driven by the first Geneva, the pull-down period can be shortened to about 1/10 of the angle it normally takes to move film. In a printer this decrease allows a 50 per cent increase in the time for exposure.

Loudspeaker and Theatre Sound Reproduction

L. Malter, RCA Photophone, Inc.

This paper is devoted to a comparison of the two chief types of loudspeakers used in theatres, viz.: directional baffle type speaker, and horn type speaker. On the basis of actual experimental measurements a comparison is made on the basis of:

1. Frequency Range.

(*Continued on page* 54)

The Amazing Efficiency of the New

DA-LITE

Trade Mark Registered

DA-TONE BEADED SCREEN is Fully Established

Why Buy New Lamps?

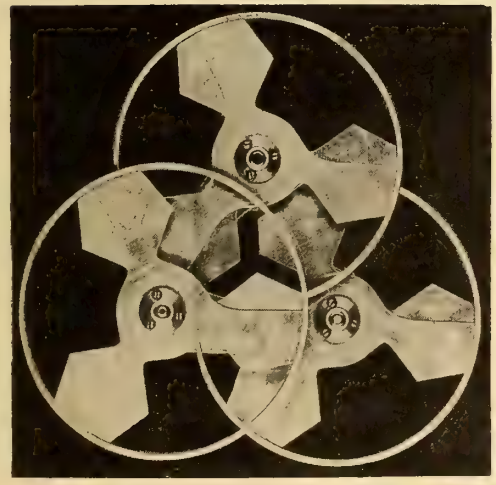
and loads of carbons to get a satisfactory picture on your screen, when you can do just that with a Da-Tone Beaded Screen at a nominal cost and resultant saving? Reduce amperage and boost your picture. No glare—No distortion—No house too wide. This screen is perforated, built on strong fireproof fabric.

Don't pass this by as just another screen. There is a whale of a difference. If your dealer cannot supply this screen, write direct.

The DA-LITE SCREEN COMPANY

2723 N. Crawford Ave. CHICAGO, ILL.

USE THE BERGER SHUTTER FOR PERFECT PICTURES



The BERGER SHUTTER

The Latest Improvement for Movie Machines

7 Important Advantages Offered by The BERGER SHUTTER

1 The Berger Shutter eliminates all flicker.
This is the improvement movie operators and movie fans have long been looking for. The shutter runs over the 60 cycle which gives a clear picture to the eye.

2 The Berger Shutter gives more light.
This shutter allows more than 50% of the light on the screen. The operator can use his present light and get a brighter effect or use less light and get as bright effect as he gets now.

3 The Berger Shutter gives a better focus and a clearer picture.
Each print is on the screen a trifle longer and the eye catches a clearer and more distinct picture.

4 The Berger Shutter clears up subtitle tails.
Because this shutter opens and closes from and toward the center from three sides, the dragging of the light does not occur.

5 The Berger Shutter prevents eyestrain.
Patrons complain frequently of eyestrain and headache caused by the flicker that now exists. The Berger Shutter remedies this. Here is a big advertising feature which should increase attendance.

6 The Berger Shutter permits a slower film run and a more natural picture.
Speed now required hurries all action on the screen. The dignified walk becomes a hurried trot. This shutter allows a 75 or thereabouts revolution and gives back the picture as taken by the camera.

7 The Berger Shutter makes a big saving in film cost.
A three reel picture can be run in the place of a four reel and give more natural and more pleasing results. Less films are required for an evening's show. Exact time of running can be fixed.

GLOBE RELIANCE CORP.

Office and Demonstration Room

29 Glenwood Ave. Minneapolis, Minn.

The use of the Berger Shutter is its best argument. Better pictures increase attendance; less light and fewer films increase profits. This shutter is the movie man's best friend. It opens the right way now to *Make Money in the Business.* It can be leased for small weekly payments and can be bought when wanted on easy terms. It will pay every movie man to look into this.

With the Silent Film, Ross swept the market. With the porous talkie screen Ross shows to even better advantage. If you are not using the ROSS F:2.4 you are not making the fullest use of the supreme art of the optician in Projection Lenses.

ROSS-F:2.4
PROJECTION LENS

YOUR THEATRE NEEDS THE
ROSS-F:2.4

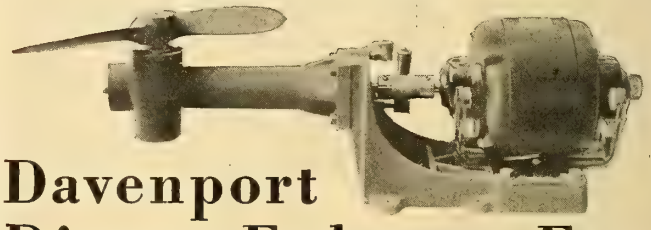
SOLE DISTRIBUTORS IN U. S. A.:—
The NATIONAL THEATRE SUPPLY CO.
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INSTRUMENTS, LIMITED
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Fresh Air in Your Booth—
It's a Necessity, Not a Luxury

INSTALLED in the average size motion picture booth the Davenport Direct Exhaust Fan changes and renews the air completely every minute. By actual test it exhausts from 500 to 4000 cu. ft. a minute, depending on the size of the vent pipe. This is many times the amount required by the Pennsylvania regulations. It gives you all the fresh air you need.

The Davenport Fan is simple and compact. It can be installed horizontally or vertically. Let us send you a bulletin that tells the whole story.

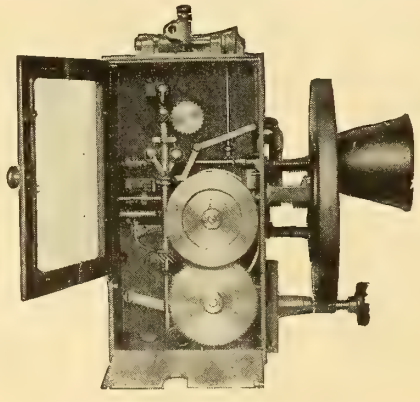
Davenport Manufacturing Co.
Meadville, Pa., U. S. A.



Davenport
Direct Exhaust Fan

YEAR IN AND YEAR OUT
THE
SUPERIOR PROJECTOR
Will give you DEPENDABLE, EFFICIENT AND SATISFACTORY SERVICE

Its many years of faithful operation has established this outstanding projector as a leader wherever long



run shows and the most exacting requirements are desired.

Place a Superior alongside your present projector and determine for yourself the results.

Manufactured by
COXSACKIE HOLDING CORPORATION
COXSACKIE, N. Y., U. S. A.

VISITRON
PHOTOELECTRIC CELLS
4 Points of Superiority



1. Longer Life
2. Non-microphonic
3. Higher sensitivity
4. Less background noise

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PREVENT STOPS
GRIFFIN FILM CEMENT
Makes a non-buckling patch that stays stuck
Specially Suited for Sound Prints
Manufactured by
F. B. GRIFFIN
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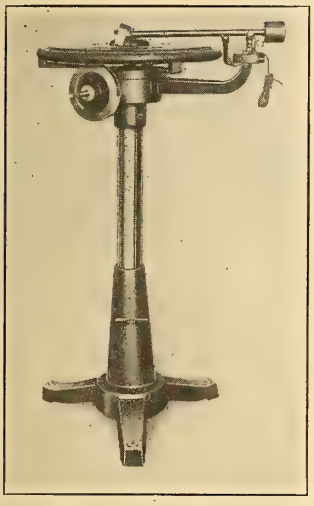
New Equipment and Appliances

Weber Announces a New Junior Syncrodisk

The Weber Machine Corporation, manufacturers of Syncrodisk Turntables, Syncrodisk Sound-On-Film and other talking picture products, now announce Syncrodisk Junior.

Syncrodisk Junior is a turntable built with the characteristic skill and care of all Weber products. It has been so cleverly simplified in design and construction that quantity production makes possible the very low price of $150 per pair including pick-ups and changeover fader. The purchaser has his choice of Audak or Erla pick-ups.

In building Syncrodisk Junior to sell for $150 per pair the Weber Company has in mind, especially, the



very small house, the country town theatre, the town hall or grange hall where movies are shown Saturday nights only, or maybe two or three times per week.

Obviously these houses cannot afford and do not need the more costly installations. Nevertheless, their patrons are just as insistent that they be shown talkies as are residents of the big cities. Now, complete sound equipment is at their disposal for the very minimum expenditure.

Syncrodisk Junior carries the same guarantee that goes with every sale of Syncrodisk products—absolute, complete satisfaction or money back.

Lens Cleaning Kit

Experiments conducted some months ago in Hollywood showed that with materials then available it was almost impossible to properly clean a photographic or projection lens. It was even found that most of the cleaning fluids then in use actually impaired the quality of the lenses. Obviously such a situation meant imperfect photography and projection. To solve this very important problem the Bell & Howell Company is presenting a special lens cleaning kit. This will meet a very actual need on the part of both amateur and professional still and motion picture camera users, as well as projectionists.

This new B & H kit consists, first of all, of a scientifically prepared fluid for cleaning lens surfaces. Lengthy experiments were conducted both in the Bell & Howell Laboratories in this country and in the Taylor-Hobson Scientific Research Division in England in order to secure just the right fluid for this purpose.

Special Chamois Used

There is also in the kit a piece of specially tanned and hand-brushed chamois leather. This unit is particularly important as it is not the regular commercial type of chamois obtainable at retail stores. Commercial chamois, it is found, frequently contains elements which of themselves provoke a stain on the special type of glass used in photographic lenses, when rubbed by this sort of leather—a stain which cannot be removed except by regrinding and repolishing the stained surface. Another item is a piece of specially selected, washed, lintless linen, made from Irish flax. Extreme care had to be exercised to secure a type of linen which would be thoroughly free from fillings and starches and at the same time leave no lint. Also included in the kit is a genuine camel's hair brush which is used to remove dust from the lens surface before applying the fluid.

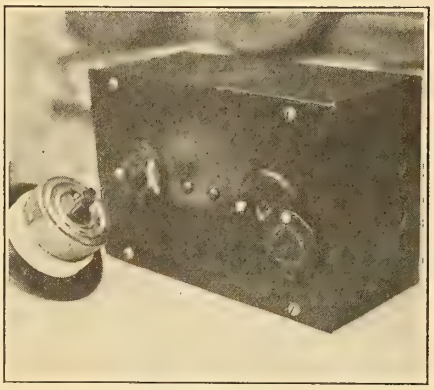
All kinds of lenses—photographic, microscopic or otherwise—will benefit by being cleaned by the materials which compose this kit. Complete but simple instructions accompany each kit and it is important that the instructions be followed carefully to secure the maximum results.

Adjustable Starting Speed For Sound Projection

Sudden starting of projectors is responsible for considerable film breakage and inconvenience to the projectionist, not to mention excessive strain and premature wear and tear on the projector mechanism. The usual starting devices employ fixed resistors, the resistance value of which cannot be altered to compensate for the "wearing in" of the projector and for other varying conditions as time goes on. Also, the usual fixed resistors frequently break down, requiring troublesome and costly replacements.

Called upon to help solve the foregoing problem, the engineering staff of the Clarostat Mfg. Co. has succeeded in developing a satisfactory solution. It is known as the Sound Projector Starting Box Clarostat, and makes possible the gradual starting of any sound projector. The desired starting rate may be adjusted to suit exact requirements at any time, and positively set for that rate until changing conditions require a change.

The equipment comprises a starter



box proper, mounted on wall, together with a special three-position snap switch mounted on plate to fit usual 4-inch round box, in place of usual starting switch. The switch is provided with "Start," "Run" and "Off" positions. The starter box is 6 x 9 x4 inches deep, provided with ample ventilation and with knockouts for BX or conduit wiring. Two bakelite covers slide back and expose adjusting screws which, by means of ordinary screwdriver, may be set for any desired starting speed.

Reelites a Great Aid for Projection Room Work

Portable hand lamps are an essential part of the lighting equipment in projection rooms, etc. For use around machines, the size and character of which prevent proper illumination by fixed lighting units; for lighting during erection of such machinery; for repairing, and for countless such jobs—Reelites are indispensable.

Portable extension lights of the usual type are an important item of expense, owing to the comparatively



Showing how Reelite is attached in extension reel for handy use

short life of the cord, which is left lying on the floor and is subjected to all sorts of abuse through being walked upon, run over, and similarly mistreated.

To take care of the above situation there has been designed and placed on the market an extension reel consisting of a casing in which is contained a reel with 25 feet of approved rubber covered cord and to which may be attached various types of wiring devices, such as hand lamps, connectors for portable drills, etc. These are furnished with a cover for at-

taching to either 3¼" or 4" outlet boxes for mounting in the ceilings, and may also be obtained with a wall-supporting bracket so that the device may be mounted on the wall for instantaneous use.

Better Lighting Aid

These devices keep the cord always out of the way—clean and unkinked. The lights are instantly available—within arm's reach—and there is no time lost in untangling cords or making extensions. They soon pay for themselves in convenience, reduced cost of cord maintenance, increasing production, and eliminating accidents. All these advantages are combined in the nationally known aid to better lighting for all jobs—Reelites.

The initial cost is but little more than that of a similar device without a reel—while the life of the Reelite extension will be from four to six times as long. Reelites are an indispensible aid to projection room work. Reelites are manufactured by the Appleton Electric Co., 1701 Wellington avenue, Chicago, Ill. and are on sale at reputable dealers.

Care and Setting of Sound Screens

KEEP your sound screen clean. Many theatres are still using the Transvox screen, which was the first screen to be used with sound reproducing equipments, where the horns were placed behind the screen. The Transvox screen material collects dust and dirt very easily. This type of screen should be dry-cleaned every ninety days and vacuumed twice monthly.

The next transparent sound screen, which was supplied with E. R. P. I. sound equipment was the Da-Tone-X screen. This is a rubberized perforated material. Definite instructions are, never to use ordinary soap for cleaning these screens, which will invariably leave clouds or streaks.

The question is asked—can the Da-Tone-X screen be washed and cleaned in a satisfactory manner? The Da-Lite screen Co., Chicago, furnish a cleansing powder in a concentrated form. Two tablespoons of Da-Tone cleaner is put into each gallon of warm water. Two one gallon pails are necessary to clean a Da-Tone-X screen and also two 1-ounce soft sponges. The cleansing fluid in one pail, and plain water in the other pail for rinsing.

Cleaning Procedure

To clean a Da-Tone-X screen, always start at the top of the screen, taking a section of three or four feet and work downward. Do not make a lap at the seams. The sponge should be kept free from surplus water. Do not allow water to run down the screen. Water should be changed frequently. Do not expect to get the surface clean the first time over. Follow the first washing with clear water without the cleaner and a clean sponge, and go over the entire surface as before. Never wash the back of the screen. Never apply Da-Tone cleaner in powder form directly to the surface, as it is too strong.

Hair Brush Cleaning

The Da-Tone-X screens should be washed as often as they begin to show streaks or spots. Water will not discolor the surface or reduce its reflective qualities. The Da-Lite Co. highly recommends that their make of screen be washed as often as necessary, which is governed by local conditions.

We shall now consider the Walker sound screens. The Walker Screen Co. will not recommend that their make of screens be washed. They advise that the screen be brushed at regular intervals of twice monthly with a soft goat's hair screen brush to obtain maximum efficiency. The method of brushing is to start at the top, brushing across the width and in coming down over the screen surface with the brush, care should be taken to avoid unbrushed laps.

The first sound installations were regarded as novelties and projection was forgotten. E. R. P. I. insisted on using the transvox screen, which absorbed about twenty per cent of the projected illumination, which ruined projection in many theatres. Where sound equipment was first installed, additional equipment, including larger motor generators and high intensity lamps, had to be installed to compensate for the light loss, due to the light absorption of the transparent screen.

Improved Conditions

This condition has been greatly improved during the last year with much research work for the perfection of an ideal sound screen without light loss. Good projection is essential in every theatre. The picture must be clear, sharp and undistorted. The old silver and gold surfaced screens are a thing of the past. The white surfaced screen has retained its position even with transparency and with perforations to transmit sound. The white surfaced, perforated sound screen gives a true, natural image without the fade-away on the angles.

Screen Masking

The masking of the picture screen is of great importance. During my visit to many theatres I find the masking either sagging at the top or bottom of the screen, and on many occasions I have noticed the side maskings slanted to the keystone of the aperture.

Some projectionists, who see the screen more than anyone else, notice detrimental things of this nature and they never say a word about it, and as long as the picture is on the screen and the sound is coming through, everything is O. K. in a small way. Boys—we must be on our feet; look, besides listening, and be positively sure that the picture looks right. The picture should always be neatly masked.

First of all, the picture should be as close to the stage floor as possible, so as to obtain a legitimate stage illusion.

Second—Where keystone exists, on angle throws, apertures should always be fitted, so that the sides of the picture are perpendicular.

Third—The black masking should cut into the picture sufficiently, so that the rough edges of the aperture are not apparent.

Fourth—The stage in front of the projection screen should be non-reflective. Stage reflection can be eliminated by laying black cloth (without shiny surface) on the stage in front of the screen. By all means, if no stage attractions are used, it should be permanently fastened to the floor.

Fifth—The corners of the projection screen should be semi-round, instead of square.—R. H. McCULLOUGH.

Sound Checking Device

A sound checking device, by which it is possible to test focus, exciting lamp current and output value of the photoelectric cell (which governs the quality of sound reproduction), has been developed by J. S. Winick, chief projectionist, and George Poporici, research engineer, of the Paramount Long Island studios, with the approval of George E. Stewart, chief sound engineer.

Requires Small Alteration

A small alteration on a sound unit is made by adding a special switch which reverses the flow of the photoelectric cell current, either for measuring or normal reproduction. Two portable boxes—one containing a microammeter and the other a set of "B" batteries and the necessary wire.

This system can be hooked up in a few minutes and the sound unit of the projection machines can thereby be brought to a perfect balance. All guess-work is eliminated and a positive setting is the result, which guarantees a high grade quality of sound reproduction, it is declared.

Utilizing Light More Fully

It is not generally known that 95 per cent of the rays emanating from our common sources of light are invisible. Mr. Haldane predicts that 50 years hence light will cost no more than one-fiftieth its present price. The alternation of day and night must, he tells us, go the way of other spacial and temporal checks: "We are working toward a condition when any two persons on earth will be able to be completely present to one another in not more than one-twenty-fourth of a second."—*London Medical Press.*

Everyday Science

"Scrambled" Speech to Keep Radio Messages Secret

TELEPHONE research engineers are working on methods of rendering radio-telephone conversation unintelligible to all except the two persons holding the conversation.

As telephone conversations are thrown across the Atlantic Ocean on radio waves, it is possible with a radio receiver tuned to the same wave length as the transmitter to listen in on the conversation.

Through the use of modulators, demodulators and filters, whereby high frequencies become low frequencies, and vice versa, a telephone conversation is rendered unintelligible to a listener-in unless it comes through apparatus which inverts the process by which the message has originally been "scrambled."

"Speech Delay Spring"

At a demonstration of this principle given by Sergius P. Grace, assistant vice president of the Bell Telephone Laboratories, at a convention of the American Institute of Electrical Engineers, at Atlanta, Ga., Mr. Grace spoke into a receiver in which was incorporated another device of the Bell Laboratories known as a "speech delay spring," by which the voice of the speaker is delayed for a period approximating two seconds. (This device was developed for use in long distance and transatlantic lines where a slight delay is necessary to permit certain contact-closing devices to operate prior to the actual transmission of the electrical speech waves.)

Speaking into the receiver Mr. Grace gave the cryptic words: "Fay-o-bonno Jaycutt Play-a-feen Crinkanope," and two seconds later from the loud speakers came the inverted words: "Allegheny Mountain Telephone Company."

Nerves Like Series of Electric Reservoirs

New evidence that the electric action of a human nerve resembles that of a series of condensers not unlike the condensers used in radio receivers, has been submitted to the Academy of Sciences, in Paris, by M. Philippe Fabre. Although the impulses that pass over nerves carrying messages of pain or sensation or taking orders to different organs of the body have long been known to be electrical, it has been apparent also that these signals cannot be simple electric currents like those used over telegraph wires.

For one thing, the nerves signals move too slowly; only some hundreds of feet a second instead of the thousands of miles a second which measure the speeds of ordinary wire-born currents. Electricians know, however, that if a series of electric condensers are connected one to the other, like a long series of reservoirs along an irrigation ditch, electricity supplied to the first condenser will fill up or "charge" it before any electricity passes on to the other condensers, just as each reservoir along the ditch will fill up in turn and overflow into the next one.

By studies of the actions of different amounts and kinds of electricity on nerves conducted in Paris under the direction of the distinguished French physiologist, Dr. J. A. d'Arsonval, M. Fabre finds that actual animal nerves pass electric pulses along their length in very much the same way as would happen in such a series of condensers linked together as electric "reservoirs."

Wooden Discs Reduce Noise in Street Cars

Among the various devices developed during the past few years to reduce noise in operation of electric street cars is one which has been developed and experimented with by engineers of the Public Service Company of New Jersey.

Much of the irritating noise in the operation of street cars comes from vibration produced by metal contact of the wheels on steel rails. Rubber pads and lead-filled grooves have been used by other street railway companies to deaden the vibration set up in the wheels.

How It Is Done

Public Service engineers bored holes in the web of the wheels, on either side of which were bolted wooden blocks of slightly larger diameter than the holes. In addition, grooves were cut around the gears and pinions and filled with lead. Canvas strips were also placed between moving metal parts to reduce scraping noises developed in operation.

These devices have been installed in one car, and preliminary tests indicate a reduction in noise of about 50 per cent. Other cars will be equipped as they pass through the shop for periodic overhaul, and if further tests are satisfactory, all cars will eventually be equipped with the new devices.

Largest Electric Lamp

The world's largest electric lamp, a monster 50,000-watt experimental bulb built recently, is like a radio tube in appearance. At the top of the bulb, a radiator made of metal fins carries off the intense heat generated by the white-hot tungsten filament, which has a temperature of 5,500 degrees Fahrenheit—twice as hot as molten steel.

The bulb is filled with nitrogen gas, whose circulation cools it and carries upward into the radiator evaporated or thrown-off tungsten particles from the filament, thus preventing blackening of the walls.

Although the present lamp is intended simply for a test by its designer, such huge lights ultimately may find use in airport lighting and for the illumination of motion picture studios.

Use Electric Refrigerator to Test Seed Corn

A huge electrically-equipped refrigerating plant has been set up in the cornfield on the Funk Brothers' experimental farm near Bloomington, Ill., by J. H. Holbert, of the U. S. Department of Agriculture, to determine what strains of corn will best resist frost and near-freezing temperatures. Professor Holbert is the man who developed the theory of temperature control in corn experiments, and is now using the famous Funk farms for carrying on his work.

The plant has been in operation for several weeks and certain strains of corn held at 32 degrees for an hour were not injured, while others more susceptible to freezing temperature were killed or plainly injured. The refrigerator is suspended on a framework and is lowered over the stalks to be tested. Four hills are enclosed at one time.

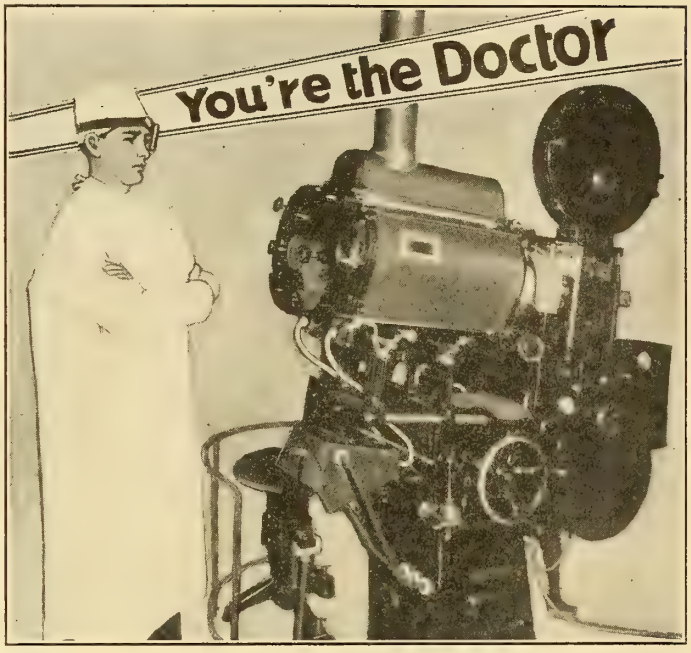
In one case, where the refrigerator had held the temperature at 32 degrees for an hour on two nights, one hybrid cornstalk remained perfectly green and natural, while another came through with one stalk in good condition and another killed.

Future Electric Lamps May Be Without Filaments

Experiments in gas-filled lamps using the rare neon and argon gases indicate that the incandescent electric lamp of today will soon be replaced by a luminous lamp containing gas of some kind, but without the tungsten or carbon filaments at present used.

The advantages expected to be obtained are longer life and less consumption of current for a given amount of light, meaning less cost to the consumer for the same amount of light, or a greater amount of light for the same money.

Lamps of this type have been used extensively in electrical signs and in fog beacons in aviation work.



But - - - - -

before buying those new lamps, so essential to the proper projection of talking pictures today, consult the man in your organization best informed on efficient equipment—your projectionist. He's sure to recommend

STRONG

Automatic Reflector Arc Lamps

For Sale By

Trustworthy Independent Supply Dealers Everywhere

THE STRONG ELECTRIC CORP.

2501 Lagrange St. Toledo, Ohio

Export Office—44 Whitehall St., New York City, N. Y.

F. S. C.

OPTICAL CROWN GLASS PLATES

To Enclose All Portholes

S. O. G.

OPTICAL HEAT-RESISTING CONDENSERS

For Projection Machines

FISH-SCHURMAN CORPORATION

45 West 45th St.
NEW YORK CITY

6364 Santa Monica Blvd.
HOLLYWOOD, CAL.

S. M. P. E. Meeting

(*Continued from page* 48)

2. Uniformity of Response.
3. Radiation Distribution Characteristics.
4. Efficiency.
5. Input Power Capacity.

The measurements indicate that the directional baffle type speaker is superior in *frequency range* and *uniformity of response*. With respect to *radiation distribution characteristics* and *input power capacity*, the two speakers are approximately the same. With regard to *efficiency* the horn type speaker is slightly superior.

These experimental measurements are then used to explain the greater naturalness of reproduction of both speech and music in theatres with the directional baffle type speaker.

Wide Film Shrinkage

A. S. Howell & J. A. Dubray
Bell & Howell Co.

In this paper the authors present some considerations on wide film shrinkage, which is a dominating factor in formulating all dimensional specifications of a new sound picture film, in order to produce good control and adequate protection of picture and sound record.

Sprocket design for projection apparatus is analyzed with reference to two film widths which apparently have gained popular favor in recent times and dimensional characteristics are proposed.

The shape and pitch size of the film perforations are discussed with a view to insure film registration and transversal, as well as longitudinal, control.

The necessity for providing three bearing surfaces for proper mechanical support of both the sound and the picture records is discussed, and some definite recommendations are made in regard to the dimensions of these surfaces and the resultant dimensions of sound and picture area with due consideration to complete utilization of the whole of the film surface.

New Recorder for Sound-on-Film

Edward Kellogg, RCA-Victor Corp.

A new model of studio recorder has recently been adopted by RCA Photophone, Inc. The most important difference between the new machine and its predecessors is in the means employed to give uniform motion to the film. A sprocket, no matter how perfectly made, nor how constant its rate of rotation, does not impart uniform movement to the film, a slight slip or jerk occurring as each tooth engages or disengages. The effect may be of the nature of a "flutterer or gurgle," but frequently has only the effect of making the high tones "wheezy" or of adding ground noise.

Constant Speed Drum

The new machine employs not a sprocket, but a smooth drum to move the film past the exposure light. In this respect it is like its predecessors.

The drum is free running, its speed being fixed by the film and varying with film shrinkage. The drum shaft carries a flywheel, and attached to the flywheel is a copper flange in which eddy currents are induced by an electromagnet which is driven at a speed about 15 per cent above that of the drum. This serves the double purpose of damping out oscillations in drum speed or "huntint," and of supplying a forward torque sufficient to overcome friction.

The result is that the film has so little to do in helping or retarding the drum, that it runs with decided locks on either side of the drum, and no jerks are transmitted from the sprockets. Considerable latitude in magnet current is possible without impairment of results, and the most sensitive tests fail to indicate appreciable variations in speed. The fact that speed constancy is not dependent on precision construction nor exact adjustment insures for consistently satisfactory performance.

Non-Intermittent Projection by Revolving Lens Wheel Mechanism

Arthur J. Holman

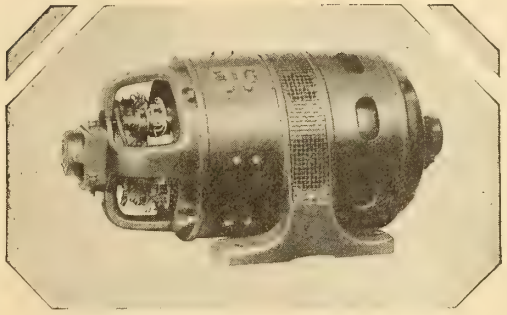
Extensive comparison tests, conducted by men thoroughly familiar with the performance of intermittent projectors, have proven conclusively that the revolving wheel projector easily produces screen images which are fully the equal of the best present day presentations as regards definition, steadiness and brilliancy. In other words, this system of projection, as embodied in a mechanism designed and constructed some four or five years ago, meets the most exact requirements of critical definition, steadiness and screen brilliancy.

The advantages of the revolving lens wheel system of projection reside in the elimination of the intermittent movement and the shutter. The uninterrupted flow of uniform and relatively low intensity light to the screen produces a clear, bright and extremely pleasing quality of picture, entirely free from scintillating effect in the highlights. Due to the continual dissolving action, which occurs between successive film frames, the appearance of graininess is greatly reduced and the action is smoothed out. These factors materially reduce eye-strain and fatigue, thus enabling the observer to enjoy to the fullest extent the improved tone qualities.

Elimination of the intermittent movement and the introduction of a scientifically designed take-up control, reduce film wear and damage to a minimum, making it possible to get several thousand exhibitions from a single print without accumulating scratches, oil and dirt over the picture area. Moreover, since the spot intensity is only half normal, the film strip is subject to very little heating effect. The aperture and gate design effectively prevent "buckling."

The optical system, easily and instantly adjustable for variation in shrinkage of film, is very simple: It contains no mirrors or prisms and does not require cams or other variable velocity devices for its operation. The system may be designed for any desired film frame size and is equally effective for 16 mm. or double width film.

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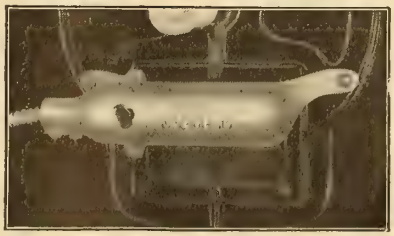
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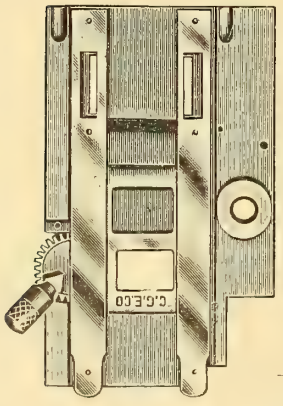
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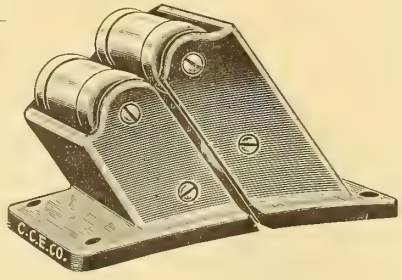
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Much Progress Noted in S. M. P. E. Report

INCREASED interest was noted in the past six months in the subject of wide films. Several different widths were proposed, and of these, 70 mm. and 65 mm. appear to have been most favored. A sub-committee of the Standards Committee of this Society held several meetings to encourage the adoption of one width as standard. The personnel of the sub-committee consisted of the leading engineer of the producing organization interested in this problem. A feature picture, "Happy Days," and a newsreel on 70 mm. film, were shown as a regular program, opening March 14 at the Roxy Theatre on a screen 41½ feet by 22 feet. Several other theatres were also equipped to handle this type of film, and at least four feature pictures were known to be in progress.

Definite advances in optical systems, processing methods, and the experience that follows production problems on a large scale, all contributed to a substantial improvement in the quality of color pictures.

Two huge sound stages have been completed in Hollywood recently by two producers. One of these comprises a theatre auditorium capable of seating 1,500 persons and a section which is also designed as a theatre stage in size, 75 feet deep, 80 feet wide, and 120 feet high. This stage has been designed particularly for the production of lavish spectacles. It is equipped with a steel curtain weighing 65 tons, and each of its 12 floor sections is fitted with a hydraulic lift. A vertical steel track, 65 feet high, permits camera shots in synchronism with the rising stage and curtain.

The increased use made of incandescent lights has necessitated the installation of refrigeration plants in studios in connection with ventilation systems.

Novel Lens Development

A novel lens device for securing wider pictures without the use of wide film is of interest. It consists of two lenses held in a mount which screws onto the front of the camera. A lateral compression of the image is produced so that nearly three times as much image is included in the normal frame. The picture is then expanded to three times normal width on projection.

Great interest has been shown in the sound school sponsored by the Academy of Motion Picture Arts and Sciences and with the completion of the fifth and sixth sections, more than 900 studio workers will have taken the course. The lectures presented by various authorities before this school have been assembled and published as a Technical Digest.

Another novel recording process is that suggested by Madelar which

records a groove on the film support by means of a diamond stylus.

Theatre Sound Level

One of several problems connected with the reproduction of sound has been the proper control of sound level in the theatre. Much use and some abuse of fader control has resulted from efforts to correct for volume variations resulting from recording sound at different levels and which were not entirely smoothed out by re-recording. One studio has devised a "squeeze track" for the purpose of adjusting these differences in level. This consists in blocking out part of the sound track by exposing it before development to a negative consisting of a black line of varying width from zero to the full track width. The positive sound track becomes a record of varying width contained between two black lines filling up the remaining space of the track on each side of the track itself, which is in the center of the space.

Equipment for cutting has been developed on a basis of the needs experienced for sound pictures and many of the make-shift devices are giving way to commercial products embodying the necessary features for handling sound films. Three designs of one type of equipment were available for sound film editing: (a) a sound picture synchronizer for use with records on separate films; (b) a disc reproducer; and, (c) an apparatus for use when sound and picture are on the same film.

Wide Film Reels

Impending adoption of wide film introduces problems for the film exchanges, since the larger reels will require larger shipping cans, and will cost more to ship because of their increased weight. An average reel of 70 mm. film weighs 34 pounds and rewinding is a man-sized job, requiring care to provent cinching or tearing of the film.

Sound picture projection apparatus is now in active use on transatlantic liners, in a Chicago hotel dining room, and even in railway cars. A successful showing on a Union Pacific transcontinental train was arranged during the fall of 1929. A Delaware corporation has been formed to promote a fleet of specially designed railway coaches as the first unit of a projected nation-wide system of mobile sound theatres to present pictures in small villages. The first theatre for the exclusive showing of sound newsreels opened early in November, 1929, running a continuous show from 10:00 A. M. to midnight.

An audible frequency selector has been designed for use of the projectionist to accentuate, attenuate, or eliminate certain frequencies delivered to the amplifier.

Unique Generator

A unique generator is being marketed by an Austrian firm located in Vienna. It is known as the Rosenberg cross-field generator. An arc, such as that, in a projector, may be connected directly to the generator and the voltage and current are self regulating. Two of the four commutator brushes are short circuited. When the outer circuit is closed, a magnetic field and an armature field results in the same direction but opposed; the former increasing slowly, the latter rapidly.

A new sound-on-film portable projector equipment by RCA was announced in October, 1929. The projector and sound reproducer is housed in a metal cabinet, 24 inches square and 12 inches wide, mounted on four telescopic legs. Film magazines are located on the art side of the case.

Further details have been made available on the portable sound equipment supplied by Western Electric. The delivery and take-up reels are included on the same shaft inside the projector case. A 60-foot throw is

(*Continued on next page*)

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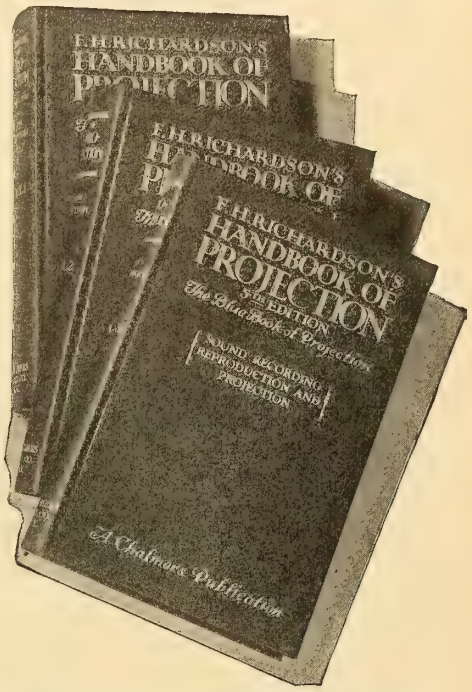
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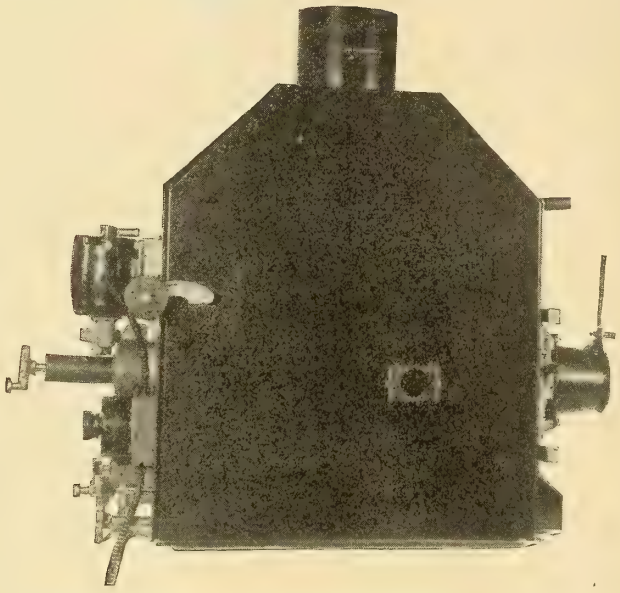
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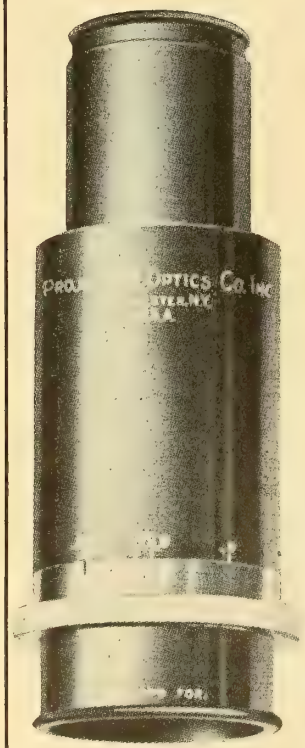
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possible giving a picture 7 feet by 8 feet in size.

New Continuous Projector

A continuous projector designed by a Frenchman, M. R. Huc, has several novel aspects to recommend its consideration. Film is passed on a curved track in the form of a part cylinder before a light aperture somewhat higher than that of a single frame. An image is projected onto a mirror in the center of the cylinder and set at an angle of 45 degrees to the light path. The mirror turns at a speed one-half that of the moving film through a slight arc and then returns to the original position, while a shutter cuts off the light momentarily. A stationary image is projected on a screen placed at right angles to the original light source.

Considerable attention has been given the theatre acoustics problem during the past year. One firm has made an acoustical analysis of over 1,500 theaters and made recommendations for treatment of the auditorium. A lowering of the accepted optimum reverberation time as a function of volume was reported. Theatres with square auditoriums were found in general to have better acoustic properties than long narrow theatres.

Sound motion pictures began to be used for non-theatrical purposes during 1929. The Hotchkiss School in Lakeville, Conn., was reported to be the first school to have sound reproduction facilities installed.

An application of the use of a sound recorded address was made in January, 1930, when a corporation president spoke in eleven different cities on the same evening at the annual President's dinner, through the medium of the sound picture. Confessions of the defendants in burglary and murder trials were recorded in Philadelphia as a part of an experimental investigation on the value of the sound motion picture in criminal court practice. It is reported that a bureau is to be established for making sound pictures of prisoners so as to have records of their voices, gestures, and mannerisms.

Novel Medical Films

Included in a group of motion pictures shown at the 1929 fall convention of the American College of Surgeons were four sound pictures, three of which were recorded addresses accompanying diagrammatic pictures while fhe fourth represented an obstetrical operation accompanied by dialogue. The operation was performed by Dr. DeLee, well known Chicago obstetrician and the dialogue was synchronized with the film by a crew of Fox cameramen. Dr. DeLee has an elaborate laboratory for motion picture photography in the Lying-In Hospital in Chicago. It is also equipped with an animation department.

Motion pictures of living cells of body tissues were made by Rosenberger working with Carrel at the Rockefeller Institute and shown at the Thirteenth International Physiologists Congress in 1929. Studies requiring days of observation were shown to an audience in half an hour. Fifteen medical films have been prepared in a program under the auspices of the American College of Surgeons, the Motion Picture Producers and Distributors of America and the East-

man Kodak Company. Subjects made recently deal with acute appendicitis, obstetrics, vestibular function and development of the rabbit's ovum.

Starch of Vienna has made ultra-rapid motion analysis studies of micro-organisms using an Askania High frequency camera. To reduce vibration effect, the camera is attached horizontally to the wall but the microscope may be used either in a horizontal or vertical position. Exposures mostly over 100 per second were used, focusing was done with a green filter interposed, and the arc current reduced to 5 amperes so as to minimize heating effects on the delicate organisms.

Television Activity

The industry is alive to the possibilities of television and further progress has been made which though rather slow is encouraging. Three producers are including reservation of television rights in their contracts. According to estimates by Jenkins, about 20,000 amateurs are receiving radio movies which are broadcast from station W3XK, Washington. Other new television stations are WENR, Chicago, operated by the Great Lakes Broadcasting Company, and W2XCR, Jersey City, and W2XCD, Passaic. The last two named stations synchronized radio with the pictures and though the images were said to be hazy, the lip movements were stated to be discernible with the sound.

A new cathode ray tube of receiver giving a picture 4 inches by 5 inches has been described by Zworykin. The method eliminates the high frequency motor previously necessary for synchronization, together with its power amplifier. No moving parts are used. A fluorescent screen aids the eye's persistence of vision and makes possible a reduction of the number of images per second without noticeable flicker. The transmitter is a modified motion picture projector with means for horizontal scanning.

The selection of standards for radio television has been discussed, including picture proportions, number of scanning elements, number of pictures per second, scanning method and direction and phase of current.

40,000 Pictures Per Second

A camera capable of taking 40,000 pictures per second by means of a drum having 180 mirrors, revolving 225 times per second was exhibited at a Scientific Congress in Tokio. The camera was designed by the Institute for Physical Research of the University of Tokyo. Lawrence and Dunning of the University of California, have been studying the characteristics of the high voltage spark by means of a camera which has a shutter speed equivalent to the taking of 250,000 pictures per second.

Cinematographic methods were used to time the high speed Schneider Cup airplane races held at Calshot, England, in the fall of 1929. A motion picture camera made pictures of the plane as it crossed the start and finish line and also recorded simultaneously the face of a calibrated Veeder counter which was actuated by a timing fork vibrating 10 times per second.

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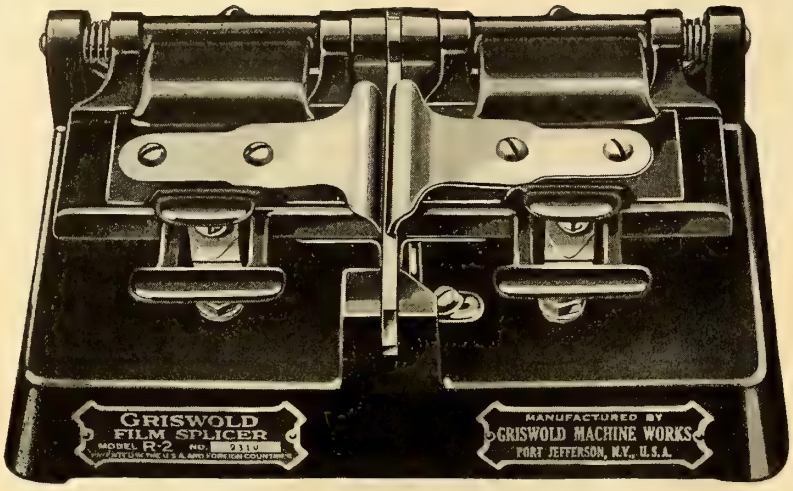
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As noted earlier in this report the use of motion pictures in color continues to expand and a number of new processes have appeared, although technical descriptions of them have been rather meager. An estimate has been made that 15 per cent of all pictures made in 1930 will be in color.

Newsreels made by a new color process were released by Pathe in March, 1930. The process is claimed to be equally as rapid in production as black and white prints and to avoid the use of filters and prisms. Pictures of the New Orleans Mardi Gras floats were made and shown in New York the following week.

In the Raycol two-color additive process, demonstrated in England, light entering the camera is divided into two parts by means of a beam splitter and is then caused by a system of rhomboids to form two images one-quarter normal size in opposite quarters of the frame on standard size film, one through an orange filter and the other through a blue-green filter. A twin lens projector with the appropriate filters over the lens superimposes the two positive images on the screen.

The Kodel camera exposes four pictures on each frame of 16 mm. film by a mechanism which introduces an alternate horizontal and vertical movement on a rear projector screen, the images being reflected from a shielded mirror onto the screen. McKay described methods of producing distortion effects by exposing motion pictures through opthalmic prisms and an auxiliary lens.



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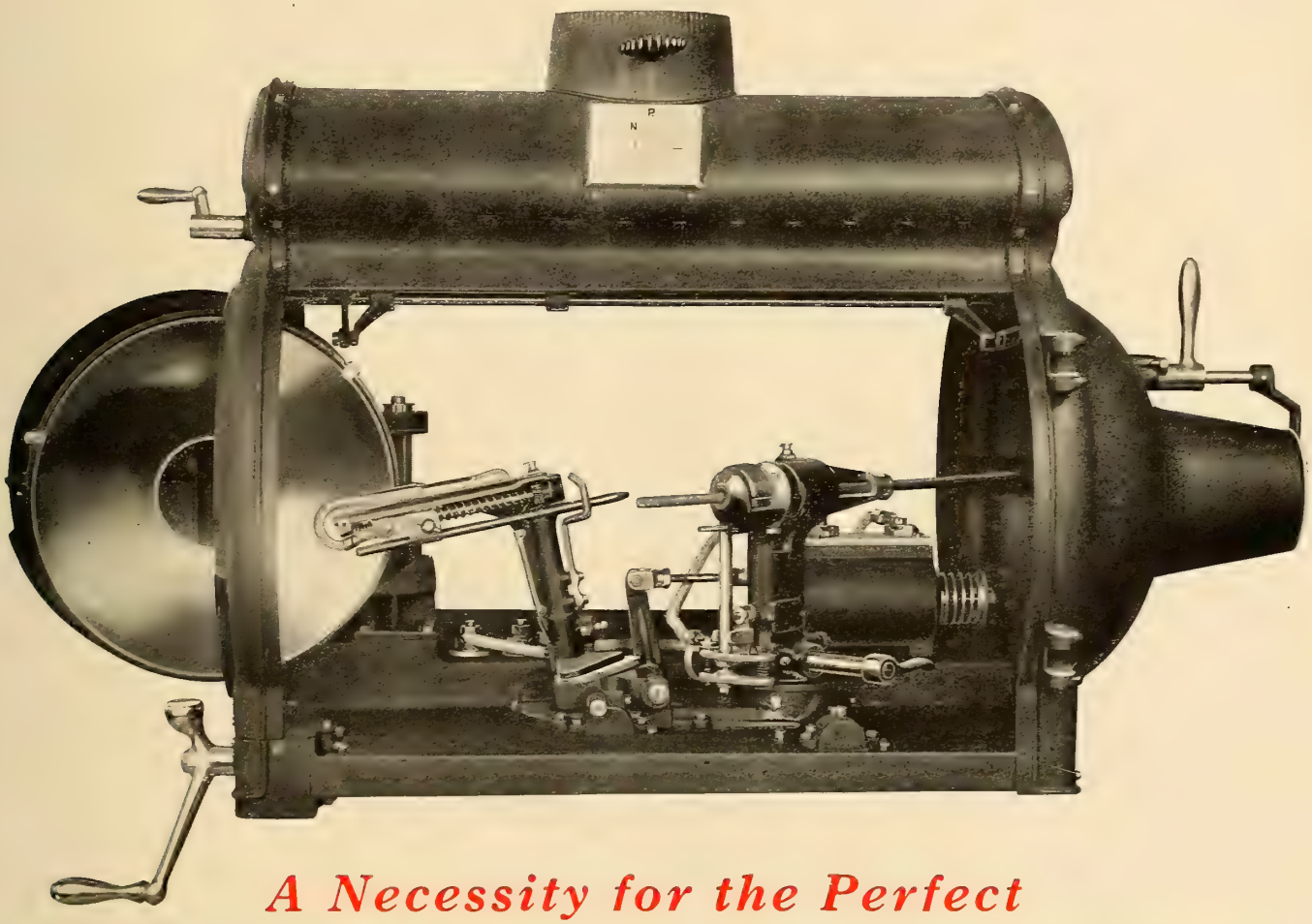
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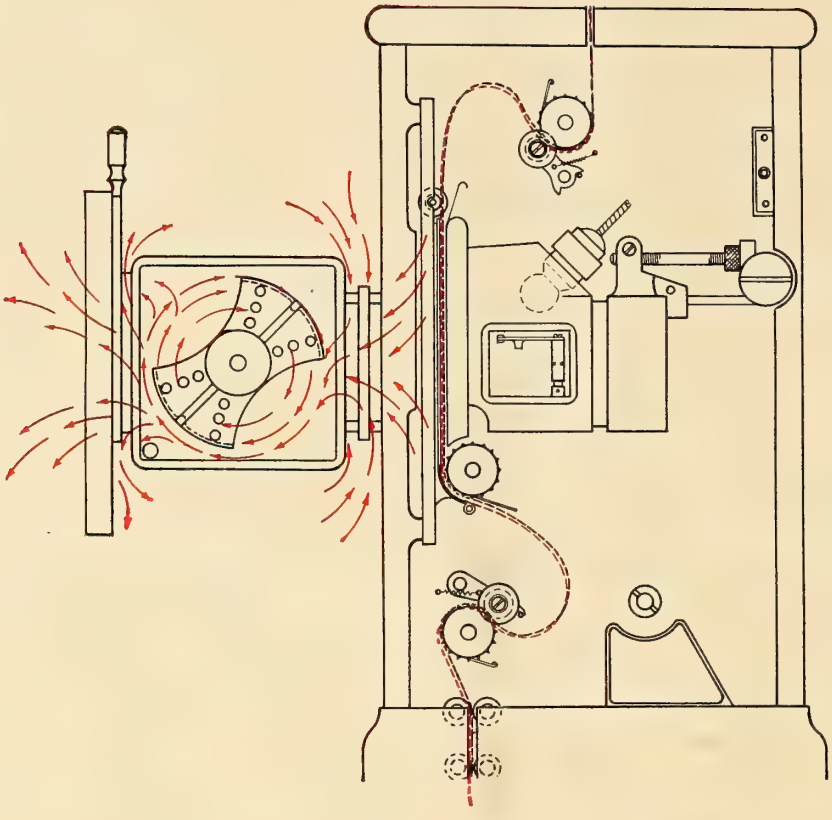
NOW USED BY HUNDREDS OF THE NATION'S GREATEST THEATRES

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DUST? HEAT?



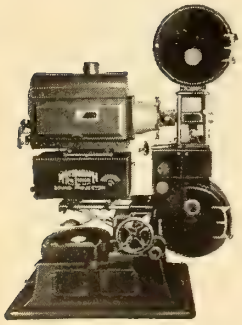
NOT WITH THE MOTIOGRAPH DE LUXE MODEL "H" MECHANISM

Follow the arrows in the above diagram. They show what actually happens to dust and heat in the Motiograph Model H Mechanism.

IT WAS DESIGNED TO DO THIS!

The wonderfully efficient horizontal cylindrical shutter operates to eliminate 62½% of the heat on the film, increase the light 15%, and it was designed to create the air current shown in the diagram to efficiently draw the heat and dust *away from* the film.





Motiograph DeLuxe Sound Projector

It keeps your film cool and clean.

It keeps your aperture cool and free from dirt and fuzz.

These are just some of the reasons why it's best for sound projection!

THE ENTERPRISE OPTICAL MFG. CO.

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MOTIOGRAPH DeLuxe TRADE MARK

MOTION PICTURE PROJECTIONIST

The International Authority

Dual Focus Type



No. 1—In position for sound film.

Shifting Rod

No. 2—Set in position for silent film.

PATENTS PENDING

Ilex F:2.5 Projection Lenses

Assure maximum projection efficiency

Greater Brilliancy

Comparative test with any other make will prove their superiority.

Now furnished in two Series—



Standard Type

THE Standard Ilex F:2.5 equipped with adjustable mechanism permitting the exact screen covering desired, within its focal range—

The Ilex F:2.5 Dual Focus type with which it is possible to maintain the same size screen covering when running sound-on-film as is obtained with silent film or sound-on-disc—

The superior optical qualities of the Standard Ilex maintained in both positions of the Ilex Dual Focus—

Inject into your screen that clean-cut brilliancy that Ilex alone can give

ILEX OPTICAL COMPANY

ROCHESTER Established 1919 NEW YORK

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JULY, 1930

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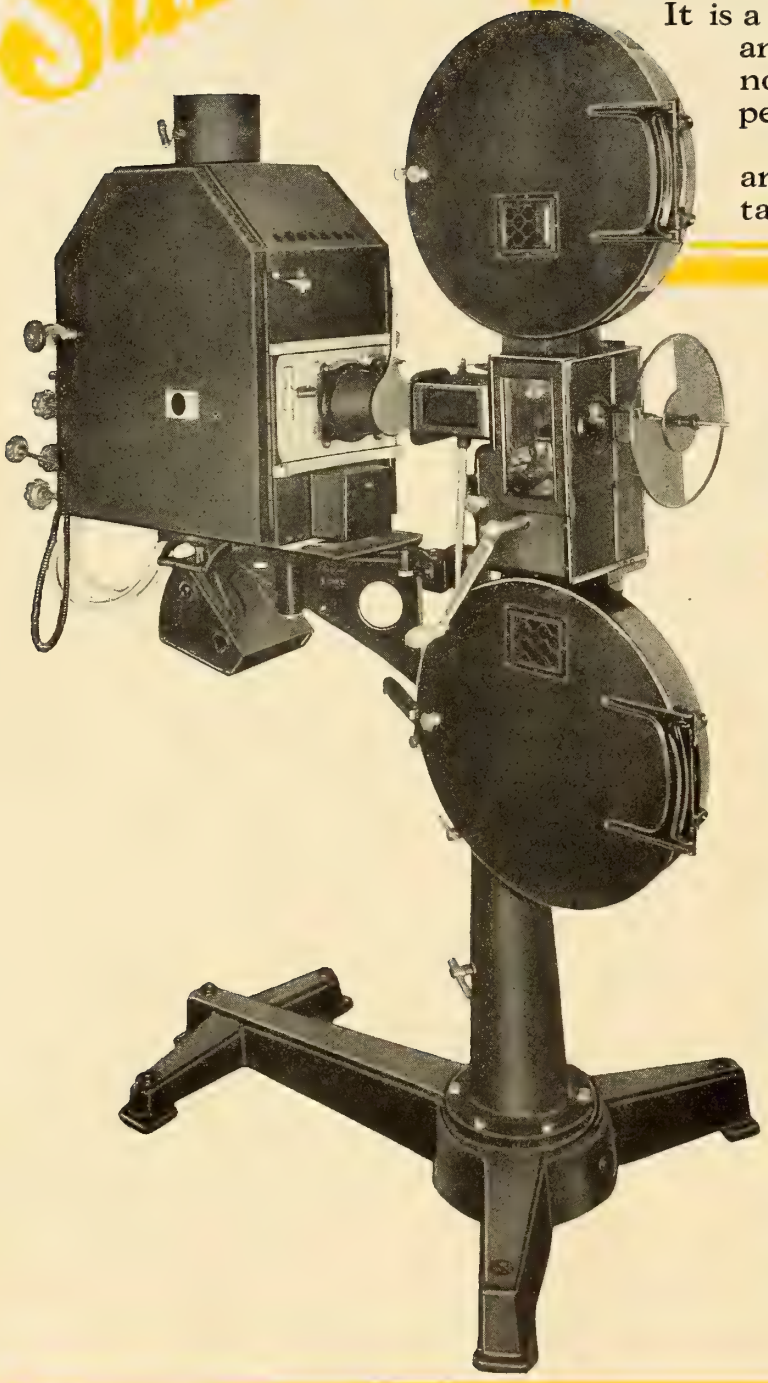
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THE KAPLAN SURE-FIT PROJECTOR

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The Kaplan Projector is guaranteed by experience and reputation.



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are known and used the world over. Each the product of carefully planned precision work and rigid inspection.

Both—the Projector and parts have been standard for many years. Able engineers, tool-makers, and machinists guided by a thorough knowledge of the exact requirements for perfect projection have combined to produce a stable and meritorious product.

With the growth of projection—sound, etc.—Sure-Fit products have grown in usefulness and dependability, meeting the most exacting demands. The most conscientious projectionist relies on Sure-Fit products because the trade-mark guarantees the merchandise.

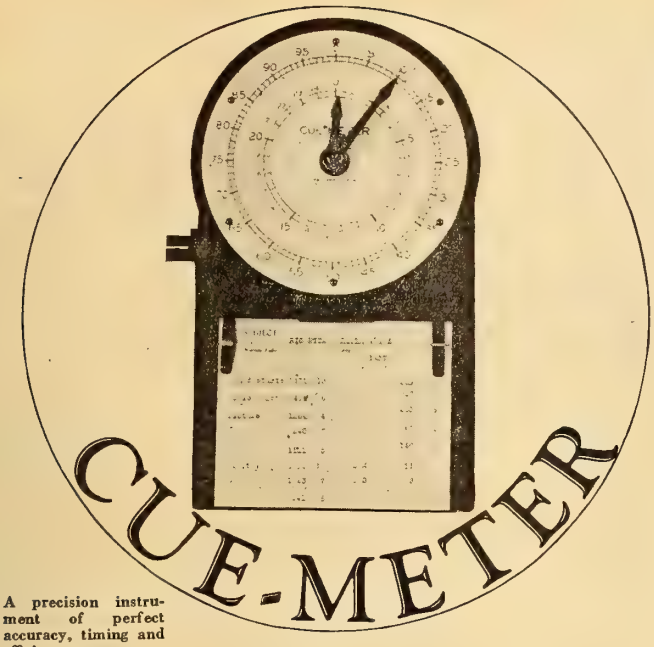
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Your dealer carries Sure-Fit parts. If he doesn't, get in touch with us and we will direct you to the nearest distributor.

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A precision instrument of perfect accuracy, timing and efficiency.

No More Eye-Strain
No More Mental Strain
No More Guesswork

This instrument watches your change-over and fader cues with absolute accuracy

Favored by projectionists on the West Coast—point of origin of the Cue-Meter—and spreading Eastward rapidly.

No *more worry about change-over cues or fader cues. more descriptive, action or dialogue cue-sheets. Not one word of sound lost, nor one foot of scene lost. Any projectionist will welcome this aid to perfect presentation. Adaptable to all projectors. Can be installed in ten minutes.*

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endorsements from outstanding projectionists:—

Mr. Chas. C. Reese, chief projectionist of the Fox Carthay Circle Theatre, Los Angeles, Calif., writes:

"Enclosed please find order for three Cue-Meters for installation on the Grand ur projectors now being installed.

"The two instruments which have been in use on our standard projectors for some time have been so thoroughly satisfactory and reliable that we would not think of going back to old cueing m thods for our Grandeur presentations.

CHAS. C. REESE."

Mr. F. E. Weaver, chief projectionist, Grauman's Chinese Theatre, Hollywood, Calif., says:

"Destined to become standard projection room equipment. As important as the projector or arc lamp. A necessity, once used, becomes absolutely indispensable.

F. E. WEAVER."

"The means for putting the fine showmanship details into the program. Perfect change-overs, stage warnings, curtain and fader cues.

A. C. 'ART' SCHROEDER."

CUE-METER is an instrument which indicates the exact number of feet of film remaining in the upper magazine and is so arranged that it may be set to designate any length of film. It will show you when to start your motor and when to make the change-over. CUE-METER also indicates exact position in the reel *at all times*, thus facilitating fader operation.

CUE-METERS are the most practical and useful addition to a projection room equipment since motors were added to projectors. They insure perfect cueing for change-overs and fader changes, without marking or mutilating the film in any manner. Absolute insurance for perfect shows.

Introduced first on the West Coast, CUE-METERS received an enthusiastic reception, with outstanding projectionists being the first to adopt them. Read what leading West Coast projectionists say about CUE-METERS—"absolutely indispensable," "as important as projector or arc lamps,"—this from your brother craftsmen.

The perfect accessory for the perfect show, CUE-METERS will soon be standard projection room equipment. Adaptable to all projection outfits—installed in ten minutes. Simply send us your name and address, and we will send you complete data on this marvelous projection aid.

SUBJECT BROADWAY Reel 1

Normal Fader	7	Length 1825 Run down to 1817		
1817	10		401	6
1773	11	Catch shots	293	12
1725	7		76	5
Orchestra starts 1431	10			
713	7			
519	8		S.M. 10	
466	7		C.O. 0	

A typical cue-sheet used in conjunction with the CUE-METER would look something like this.

See your local supply dealer

Manufactured and Distributed by

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THEATRE ENGINEERING SERVICE CO.

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WORN OUT and DEFECTIVE PROJECTORS

Cause damage to prints
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Handicap the projectionist
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Greatly Reduce
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MOTION PICTURE PROJECTIONIST

July, 1930 Vol. 3, No. 9

JAMES J. FINN, Editor

Frank R. Day, *Personnel;* Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* Arthur Gray, *Conservation;* Rudolph Miehling, *Sound;* John Kieley, *Equipment;* Samuel Wein, *Research;* R. H. McCullough, *Studio Contact;* Harry Rubin, *Improvement.*

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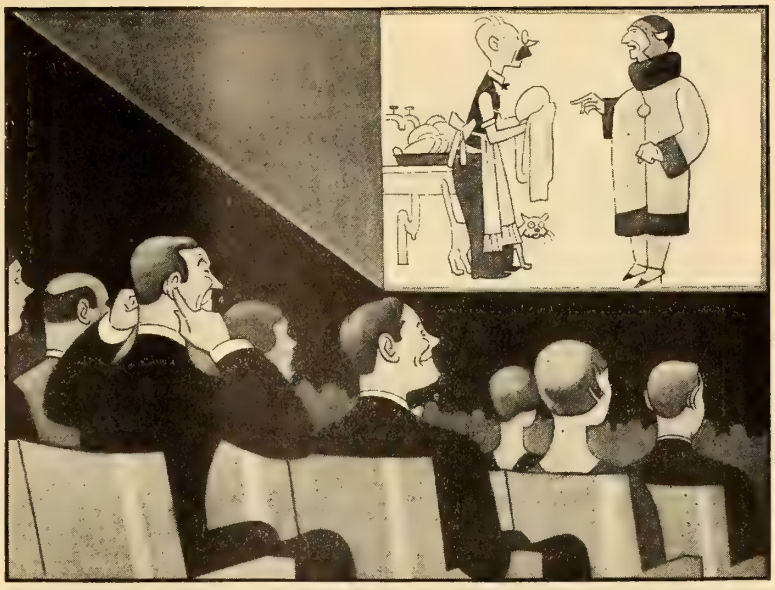
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An Efficient Recording Staff Insures Good Prints

AN insight into the many studio activities which may have an important effect on the finished product as shown in theatres is given in the following excerpt from an article by Carl Dreher in *The American Cinematographer.* Mr. Dreher, formerly chief engineer for RCA Photophone, Inc., is now Director of Sound at the RKO Studios in Hollywood. The excerpt follows:

Projection, although a dual function, with picture elements of as much importance as the sound, is in most studios under the control of the sound department. This reason is simply one of expediency. When sound invaded the industry, picture projection had reached the stage where no serious difficulties were encountered, whereas sound projection presented numerous problems of personnel training and addition of equipment. Projection as an uncertain factor in the judging of sound recording may



SOUND OR SILENT—

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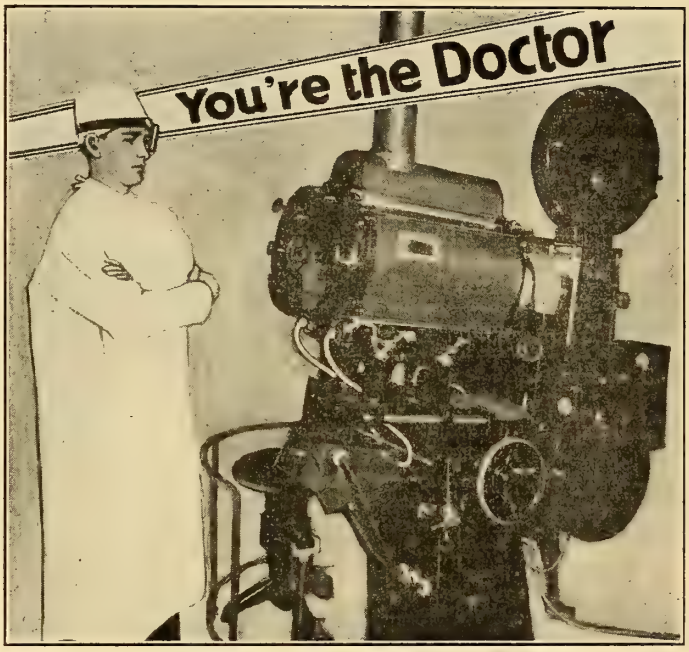
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Authorized distributors for
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Complete Sound Picture Service!

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But - - - - -

before buying those new lamps, so essential to the proper projection of talking pictures today, consult the man in your organization best informed on efficient equipment—your projectionist. He's sure to recommend

STRONG

Automatic Reflector Arc Lamps

For Sale By

Trustworthy Independent Supply Dealers Everywhere

THE STRONG ELECTRIC CORP.

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OPTICAL CROWN GLASS PLATES

To Enclose All Portholes

S. O. G.

OPTICAL HEAT-RESISTING CONDENSERS

For Projection Machines

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HOLLYWOOD, CAL.

entail a serious division of responsibility if it is assigned to another department, although here, as in many other instances, much depends on the individuals.

Where the problem is not solved by handing over studio projection *in toto* to the sound department, at least the maintenance of the sound reproducing machinery is delegated to it. Some sound departments also employ one or more technicians as theatre contact men to check up on conditions of sound reproduction in the field. This is obviously a prudent measure, since too often infinite pains are taken by the producing staff (and an almost infinite amount of money spent), with everything that goes into the negative, after which all hands trust to luck in the presentation of the picture to the public. As far as quality of release prints is concerned, it is gratifying to note that the Academy of Motion Picture Arts and Sciences is taking appropriate action to remedy the present deficiencies.

Development and Research

Development and research are obviously topics of importance in an industry as wholly dependent as motion pictures on technological factors, which are still far from a state of perfection. In general, fundamental problems of sound recording and reproduction are best handled in the laboratories of the equipment manufacturing concerns, but many problems, such as camera-silencing, set construction, correction of acoustic defects by re-recording, etc., require work in the field.

Sensitometry, and the control of photographic elements in the developing and printing of sound tracks on film, are of obvious concern to the sound engineer, since the most carefully exposed sound negative may be ruined by poor processing in the laboratory, and, conversely, lack of correlation between the photochemical elements and exposure conditions may result in degradation of quality or even loss of takes. One or more photographic specialists are therefore found on the staff of every adequately organized sound department, and a routine of test strip preparation to indicate optimum conditions of development is carefully maintained.

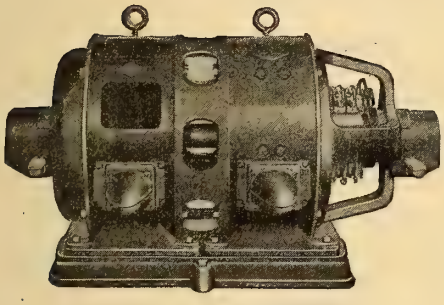
S. M. P. E. Chicago Section

O. F. Spahr, President of Enterprise Optical Mfg. Co., which manufactures the Motiograph projector, has been named to the Board of Governors of the Chicago Section of the Society of Motion Picture Engineers.

The boundaries of the Section were set as a line running north and south through a point 50 miles west of Cleveland and a line running north and south through a point 50 miles east of Denver, the north and south boundaries to be those of the United States. It was also decided that a dinner meeting shall be held once every month.

LOW MAINTENANCE COST *for users of* IMPERIAL M-G SETS

QUALITY PROJECTION



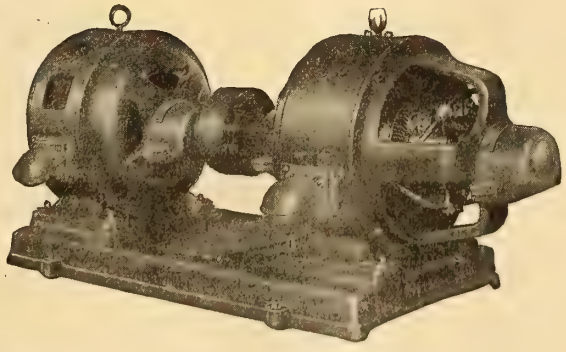
For Small Theatres

Your success depends upon your ability to obtain Quality Projection and your best interests are served by using Imperial Motor Generator Sets. They are the product of 40 years Motor building experience and are especially designed for Motion Picture Projection.

You will obtain many years of satisfactory service from Imperial Motor Generator Sets that will be free from annoying break downs. This naturally results in Low Maintenance Cost. Ask your dealer or write us.

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WESTON MODEL 547
The Accepted Standard for Servicing Sound Equipment

"Since the advent of synchronized sound with the motion picture, new problems confront the Projectionist. Chief among these is the proper operation and maintenance of the electrical equipment. The efforts of the entire motion picture industry and allied manufacturers are judged more or less by the results seen and heard at the theatre, and it is from these results that support for further development is derived. One of the necessary means of securing proper operation and maintenance of the electrical equipment is through the use of electrical measuring instruments."

In this quotation from a recent editorial article on Servicing Sound Equipment is found recognition of the need for frequent electrical inspection of amplifiers and tubes, as well as the electrical circuits concerned with proper functioning of sound equipment. And in this new field, as in all others where electrical measurement is essential to efficient service, engineers and projectionists are turning to Weston instruments.

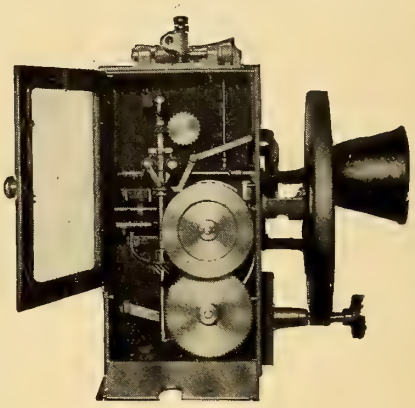
The illustration shows a compact, portable equipment, known as the Weston Model 547 Radio Set Tester, recommended for this purpose. It comprises three instruments mounted in a durable Bakelite case with removable cover, and connected through a system of switches and binding posts so arranged that each instrument and range is automatically connected in circuit for every required measurement. Comprehensive in scope and simple to operate. Write for full particulars.

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PIONEERS SINCE 1888
INSTRUMENTS

WESTON ELECTRICAL INSTRUMENT CORPORATION
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The Superior Projector
Best for
SOUND PROJECTION

Adapted to all Leading Sound Reproducers



Manufactured by

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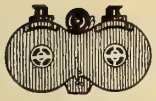
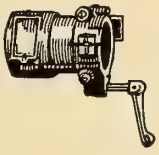
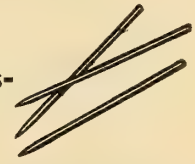
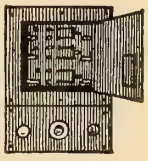
Whilst attractive surroundings undoubtedly "draw" the public, it is only the quality of the "goods" you offer that converts them into regular patrons. The most apathetic member of your audience will readily appreciate the difference if you install—

THE ROSS
F:2-4 PROJECTION LENS

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NATIONAL THEATRE SUPPLY CO.	INSTRUMENTS LIMITED
CHICAGO	OTTAWA

LITTLE THINGS THAT MAKE BIG DIFFERENCES


Booth accessories, too, have had their day of revision to meet the requirements of talking  pictures. Scores of new devices have been thrust on the  market during the past year. Which make actual   contributions to better projection? Which are of doubtful  importance?  NATIONAL answers the question for you. Every item  offered as a part of its complete line of accessories  for "sound" has been thoroughly investigated and rigidly tested. This assurance of  practicability  is of utmost importance to the exhibitor. Sound accessories are   little things . . . little things that make big differences! 

When you find this Stamp of Approval in advertisements of theatre equipment and supplies you know: That the National Guarantee of highest quality is coupled with that of a manufacturer; that the product may be depended upon to give satisfactory service; that it may be purchased at any National branch and that its price will be right.

NATIONAL THEATRE SUPPLY COMPANY
Branches in all Principal Cities

General Officers of International Alliance 1930-32





Photo by Weaver, Los Angeles, Calif.

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Printed in MOTION PICTURE PROJECTIONIST, July, 1930

Delegates to and guests of the 30th Convention of I. A. T. S. E. & M. P. M. O. U. assembled at Fox Film Corp. "Movietone City" in Hollywood, California, June, 1930

Photo by Weaver, Los Angeles, Calif.

30th Convention a Great Success

"THE greatest ever," is an outworn phrase as applied to conventions of any sort, yet it is the only phrase that could accurately describe the 30th Convention of the International Alliance in Los Angeles, June 2-5. Never was there such a locale for any I. A. Convention, and all those delegates who were visiting California for the first time went, gaped and were conquered. California unfolded its matchless scenic pageant to the wonder of the delegates, thereby preserving the reputation of the resident realtors; the Convention sessions were busier than ever and accomplished more work; the district meetings developed a spirited exchange of ideas; and last, but by no means least, representatives of the five Los Angeles Local Unions who acted as the General Arrangements Committee showed the delegates how to put on a *real* Convention.

"Biggest Show on Earth"

Space does not permit of a detailed exposition of the activities of the Convention as a whole, thus this article will concern itself merely with the highlights.

The Convention activities really got under way on May 6th, a month before Convention time, when the General Arrangements Committee successfully staged "The Biggest Show on Earth," to help defray expenses of the Convention. This show, staged in the Shrine Auditorium in Los Angeles, was the talk of that city for days afterward. Everybody who is anybody in stage and screenland volunteered their services, and the show played to a capacity audience of more than 6,500 people. Thus fortified financially, the L. A. boys went ahead and arranged for the Convention.

Notables Welcome Delegates

The Convention was officially opened on June 2 at 10:30 A. M. in the Rose Room, Los Angeles, by William Scott, representing the joint California Committee. Brief addresses of welcome preceded the first roll call, the speakers being William Scott, who extended the welcome of the five affiliated local organizations; Secretary-Treasurer J. W. Buzzell of the L. A. C. L. C., who welcomed the delegates on behalf of the California labor unions; Sheriff W. I. Trager of Los Angeles County, who extended the facilities of his private hostelry; and Hon. John C. Porter, Mayor of Los Angeles, who tendered the mythical key to the city to all present. The next speaker was Governor C. C. Young of California, who extended greetings and complimented the I. A. on their work in the amusement field.

The first business session followed the conclusion of Governor Young's remarks. First there was presented the report of the Credentials Committee, consisting of the official list of delegates present. This list, which is appended hereto, showed that 654 Local Unions were represented by 846 delegates.

Committee Chairmen

Announcement of committee appointments disclosed the chairmen to be as follows: *Resolution Committee*, Fred J. Dempsey, 1st V. P.; *Grievance Committee*, William P. Covert, 2nd V. P. *Auditing and Finance Committee*, Cleve Beck, 4th V. P.; *Special Committee*, George E. Browne, 5th V. P.; and *President's Report Committee*, William C. Elliott. The first session was adjourned at 11:40 A. M.

Shortly after this business session the entire Convention personnel boarded busses for Fox Movietone Studio, where they were greeted by many motion picture actors and actresses. After inspection of "Movietone City," as the studios are known, luncheon was served upon one of the big stages. A group photograph of this gathering is reproduced elsewhere in this issue.

At 3:30 that afternoon all delegates and guests embarked on a trip through Hollywood, into Los Feliz Canyon, across Hyperian Bridge, through Chevy Chase, Flintridge, beyond Devil's Gate Dam, and out into Pasadena and San Gabriel. In the evening at 7 the downtown section of Los Angeles was a blaze of color as a result of the greatest lighting demonstration ever put on in the motion picture capitol. Hundreds of arc lights and incandescent rifles were employed in making this a marvelous exposition of color lighting.



Sidney Burton, V.P. of P. A. C. and Pres. of Chapter 7, A.P.S., who is responsible for much of the splendid work being done on the Coast

Second Day's Session

On Tuesday morning the delegates repaired to the convention hall for the second day's business, the while the guests got an early start for the Catalina Island trip, which required a full day. The second business session was opened at 10:15. After the reading of a half-dozen communications of general interest, 1st V. P. Dempsey took up the reading of the report of he General Executive Board. While a majority of the resolutions embodied in this report met with the unanimous approval of the Convention, several matters of general policy, jurisdiction, etc., provoked some highly interesting discussion which undoubtedly clarified the issues under consideration and charted future policies of the Alliance under similar conditions.

The balance of the second day was given over to the meetings of the various committees, interspersed with district gatherings. In the evening the delegates were the guests of the five L. A. local unions at boxing contests in Olympic Auditorium.

Third Day's Session

The third day's session was opened at 10:30 A. M. A number of announcements were read, and also a number of greetings, among the latter being one from President Joseph Weber of the A. F. of M.; one from Nat Golden, U. S. Dept. of Commerce; Mathew Woll, President of the Union Labor Life Insurance Co., and the Grand Lodge, T. M. A.

Speakers at the morning session were Delegate Alivn Wyckoff, L. U. 659, who as president of his organization called attention to the publication *International Photographer*, cameramen's publication. Mr. Wyckoff pledged the support of his Local and their publication to all the endeavors of the I. A.

Boone Mancall, publisher of *Motion Picture Projectionist*, was next presented to the Convention. Mr. Mancall expressed his pleasure at renewing acquaintances made at previous Conventions and assured the delegates of his support in their activities. Dwelling briefly on the progress of *Motion Picture Projectionist*, Mr. Mancall cited the growth and standing of the publication as an index to the progress made by the craft within the past few years. He also an-

nounced that he had undertaken the publication of another journal, *Theatre Engineering* which he said should prove of real value to members of the Alliance.

Resolutions Report

In making an announcement relative to resolutions, 1st vice-president Dempsey had the following interesting comment to make: "Strange though it may seem, the history of the Alliance will show that this Convention has witnessed the smallest number of resolutions submitted—ample evidence of the efficient conduct of I. A. business."

The next important business was the reading of a report of the *Resolution Committee*. Embodied in this report were resolutions affecting the relationship between operators' and stagehands' local unions; present relations between the I. A. locals and musicians locals; the servicing of projection room equipment by I. A. members; and a resolution calling on the Alliance to combat with every weapon at its command the attempted formation of a new "bootleg" union, organization of which was started in Western Canada.

Finances in Good Shape

The report of the Finance and Auditing Committee paid high praise to the manner in which the accounts and funds of the Alliance were handled, and it also recommended a vote of thanks to the General Office for its cooperation. At the conclusion of this report a motion for adjournment was made and carried.

Wednesday evening was devoted by some to a trip to adjacent mountain tops where a superb view of the country for many miles around was available.

The fourth and last day of the Convention was devoted to final reports by the committees and the nomination and election of I. A. officers. Committee recommendations were approved in nearly all instances, and discussions was confined in the main to clarification of certain points of a few resolutions.

Election of Officers

Delegate Harry Griffin of Detroit Local Union 39 was granted the floor, and he made the following statement: "I am about to place in nomination for the office of President a man whom you all know. Over a period of sixteen years he has served as an International Officer, and I can say without contradiction that his ability for his office is unquestionable. I deem it a great privilege at this time to place in nomination for the ensuing term the name of William F. Canavan for President."

A burst of applause greeted this announcement. No other name was offered for the office, so the nominations were declared closed. In rapid succession the following nominations were made and the men were elected:

First vice-president, William C. Elliott; 2nd v.-p., William P. Covert; 3rd v.-p., Cleve Beck; 4th v.-p., John P. Nick; 5th v.-p., William Harrer; 6th v.-p., Joseph Campbell; 7th v-p., William Madigan; and General Secretary-Treasurer, Fred J. Dempsey. The retiring officers were Richard J. Green as General Secretary-Treasurer, George E. Browne as 5th vice-president, Harry Dignam as assistant president, and William D. Lang as manager of the claim and adjustment department. Louis Krause, of Philadelphia, is now serving as assistant to the president, and it is expected that a permanent appointment to the claim department post will shortly be made.

The International Board of Trustees is comprised of William C. Scanlon, Walter Croft, and John McCarroll, the latter two being new appointees. The delegates to the American Federation of Labor conventions will be James Burke, of Boston, and Harry Griffin, of Detroit. William E. Johnston will represent the Alliance at the Dominion Trades and Labor Congress.

As the time for the installation of the re-elected and newly elected officers drew near, vice-president Dempsey requested John J. Fanning of Chicago, Ill., Local No. 2, one of the oldest members in the Alliance, to proceed to the platform and officiate at the installation and obligation of officers.

Canavan Closes Convention

Just before adjournment President Canavan arose and addressed the Convention as follows: "I am sure the delegates realize the tremendous amount of effort and money that has been spent by the five Los Angeles local unions to make their stay a pleasant one. This was the acme of all entertainments ever accorded our conventions. I want to thank you gentlemen here in California for what you have done for us.

"I also want to thank the Convention for the consideration shown me, I haven't been as strong as I might have been here, but I shan't give up so easily. I wish every delegate a speedy travel home, and I certainly wish you every success in the future. A motion for adjournment is now in order." . . . . And thus was closed the 30th Convention.

The 30th Convention was really an inspiring sight, particularly from the viewpoint of the labor unionist. For there were gathered more than 850 men to work for a common purpose, to better their craft within itself and to improve its relations with others. Differences of opinion there were, of course, yet in every case those who supported the minority view of a given question acceded with fine grace and sportsmanship to the opinion of the majority for the common welfare.

Pervading all business sessions of the Convention was a note of progressivism and keenest interest in all problems. It is to be regretted that some of the more important questions which were settled at the meetings cannot be given in detail here; but their publication in this place is not imperative. When the various local unions are presented with a report of the Convention proceedings they will discover that their welfare has been materially advanced.

The 30th International Alliance Convention is now a thing of the past, but it will linger long in the minds of the delegates and its effects will be evidenced in many ways during the ensuing two years.
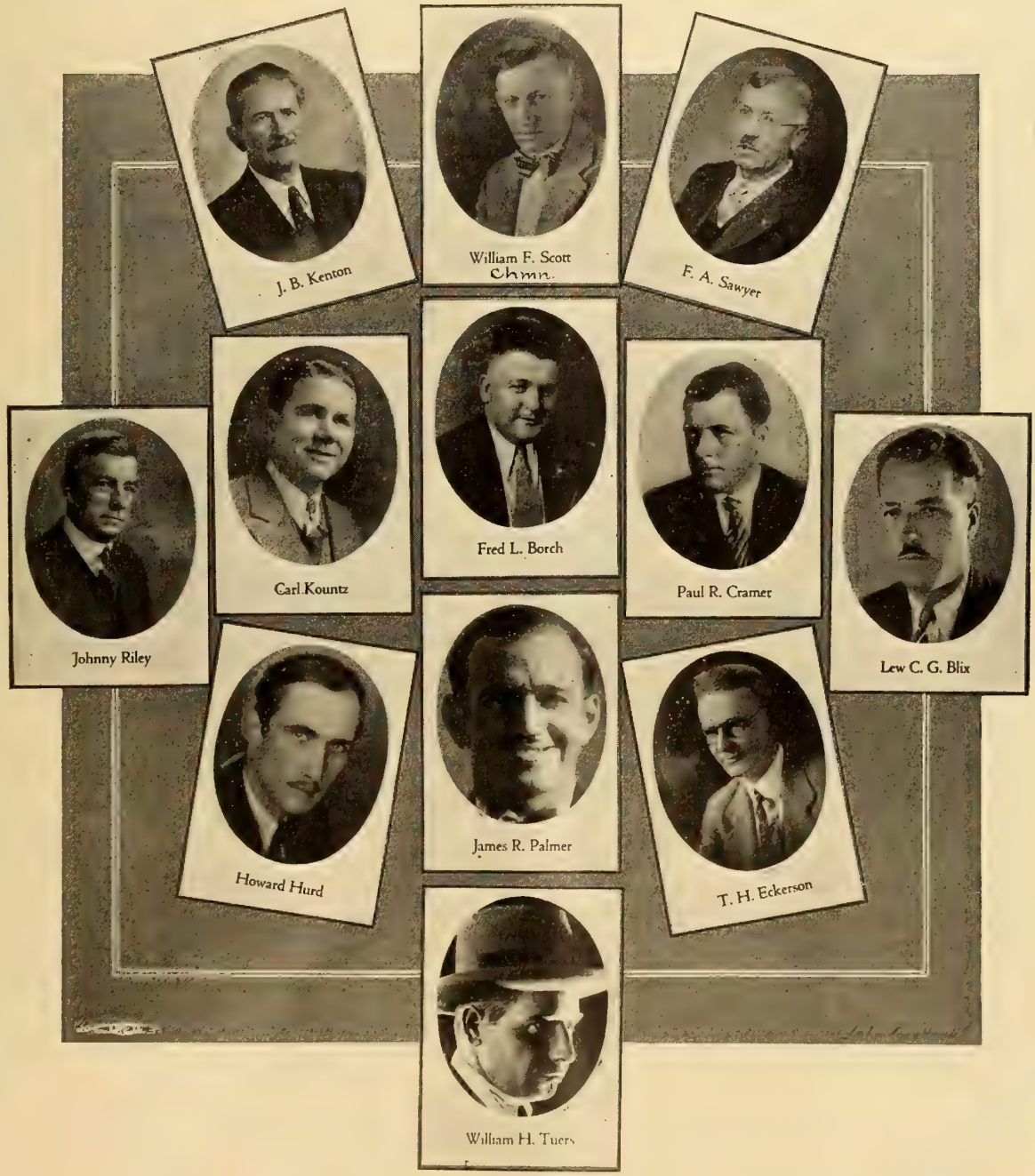
Convention Delegates

The official list of delegates accredited to the Convention by the Credential Committee is as follows:

Local	City and State	Delegates
1	New York, N. Y.	J. Magnolia H. Dignam J. C. McDowell W. J. Maher E. Gately H. Griesman T. McGovern I. J. Brennan S. Goldfarb B. Anstett
2	Chicago, Ill.	Wm. Schraub James T. Ryan John S. McCloskey Arthur Morrison Larry Cassidy Mark Morrison John J. Fanning Frank C. Olsen
3	Pittsburgh, Pa.	James N. McGrath, Jr. R. H. Bentel
4	Brooklyn, N. Y.	B. J. Ryan Linford Risley D. T. Rader Richard Walsh
5	Cincinnati, Ohio.	Edmund Callahan Andy Bolan
6	St. Louis, Mo.	William Nick C. O. Newlin Charles Le Roi
7	Denver, Colo.	George W. Brayfield Frank G. Lemaster
8	Philadelphia, Pa.	Charles Havic Chas. O'Halloran John J. Shanahan John Pickering James Crockett
9	Syracuse, N. Y.	Edward Fitzgerald Wm. J. Cushing
10	Buffalo, N. Y.	Edward F. Moest Carl Keller
11	Boston, Mass.	James J. O'Brien James Hayes George E. Curran Charles Fossa Samuel E. Horton
12	Columbus, Ohio.	Larry Buck Herbert Schell
13	Minneapolis, Minn.	Roy Wier
14	Albany, N. Y.	Jacob Bain
15	Seattle, Wash.	Floyd E. Hart Ernest A. Clark
16	San Francisco, Cal.	William G. Rusk George Ward
17	Louisville, Ky.	Phil Greenberg Mike Joseph
18	Milwaukee, Wis.	Harry Martin Louis Landon
19	Baltimore, Md.	J. E. Buckingham Wm. Slater
20	St. Paul, Minn.	Joseph H. McHugh
21	Newark, N. J.	Louis J. Havell Daniel Cassidy
22	Washington, D. C.	Thos. I. Trundle George Donaldson
23	Providence, R. I.	Thos. E. Gannon Fred. W. Newcomb
24	Toledo, Ohio	John J. Russell
25	Rochester, N. Y.	Michael Mongovan Charles Cole
26	Grand Rapids, Mich.	Frank F. Young
27	Cleveland, Ohio.	Manus McCaffery Thos. Canton, Jr. James F. McCaffery

(*Continued on page* 44)

General Arrangements Committee for 30th I. A Convention



To these members of the five Los Angeles Local Unions must go the credit for making the 30th Convention the big success it was. Beginning with "The Biggest Show on Earth," a spectacular showmanship feat, these men ran things in splendid fashion throughout the Convention.

Loudspeaker Types and Theatre Sound Reproduction*

By LOUIS MALTER
RCA Photophone, Inc.

THE ultimate goal in theatre reproduction of sound motion pictures is the complete simulation in each part of the theatre of the sound originally impinging upon the pickup microphone. This goal is at present far from having been achieved, one of the weakest links in the chain between sound striking the microphone and the sound impinging upon the ear of the auditor being the loudspeaker.

At the present time the two chief types of loudspeakers in use in theatres are the cone speaker with the directional baffle and the horn type speaker.

In the following discussion the elements which measure the satisfactoriness of a loudspeaker, and the influence of these elements on the reproduction obtained from the two types of loudspeakers mentioned above, will be considered. The results of certain measurements will be used to explain the quality of the reproduction obtained with each type of loudspeaker in theatres.

The extent to which a loudspeaker can deliver reproduction is measured by five factors, which may be classified in order of importance as follows:

1. Frequency of range.
2. Uniformity of response.
3. Radiation distribution characteristics.

If the pressure at a great distance from the speaker is measured at various angles with the normal to the mouth of the speaker a continuous curve is obtained. If the intensity along the normal is set equal to unity the curve obtained is defined as the radiation distribution is obtained. The family of curves showing the radiation distribution characteristics throughout the frequency range is a measure of the quality of reproduction at various angles to the normal. The ideal characteristic is that in which the intensity is uniform for all frequencies throughout the angle defined by the entire audience in a theatre at the center of the speaker mouth and which then falls off to zero very sharply outside this angle.

4. Efficiency.

The absolute efficiency of a loudspeaker is defined as the ratio of the total acoustic power radiated by the loudspeaker to the total acoustic power radiated by an ideal loudspeaker if fed from the same electrical source.

5. Input power capacity.

The input power capacity of a loudspeaker is measured by the value of $\frac{e^2}{4r}$, where e is the maximum open circuit voltage which can be impressed upon the loudspeaker terminals without producing noticeable distortion, and r is a resistance equal in magnitude to the impedance to which the speaker is designed to be connected.

In order to obtain an accurate and absolute comparison between the performance of the "directional baffle type" loudspeaker and the horn type loudspeaker, frequency response characteristics of the most widely used type of directional baffle type loudspeaker and of the most widely used type of horn loudspeaker were obtained in the following way.

Mode of Testing

Each loudspeaker was placed on the ground out-of-doors pointing directly upward and at a sufficiently great distance from buildings so that reflections from these did not affect the results obtained. A condenser microphone was suspended directly above the center of the loudspeaker mouth at a distance of 200 feet. The condenser microphone was connected to a sound amplifier. The entire sound measuring equipment was corrected electrically so as to possess a uniform overall frequency characteristic.

The frequency-response characteristics obtained in this manner are correct down to a frequency at which the radiation distribution characteristic of the speaker becomes so broad that sufficient sound is reflected from the ground to interfere with the radiation shooting straight up. In order to obtain the frequency characteristic for the *lower* frequencies, the speaker is placed along the ground with its mouth pointed towards the condenser microphone, which is placed close to the ground and at a distance of 20 feet from the speaker mouth. In this case the phase difference at the microphone between the direct radiation and that reflected from the ground is negligibly small at low frequencies so that the actual low frequency characteristic is obtained. This low frequency characteristic, however, must be divided by two due to reflection from the ground. (The assumption of practically complete reflection from the ground has been checked by experiment.) The fact that over a certain region (300 to 500 cycles), both methods yield the identical result is a further check on the composite method.

The beat-frequency oscillator and high quality amplifier used in making the measurements were set up indoors and leads run out to the speaker and the bullet amplifier associated with the condenser microphone. A complete description of a similar sound pressure recording mechanism has been previously published.[1]

Experimental Results

The frequency response characteristics obtained are shown in Fig 1. In order to enable a fair comparison to be made between the frequency characteristics of the two types of speakers the two frequency response curves have been so placed as approximately to overlap in the center of the range, *i. e.*, between 300 and 800 cycles. This has necessitated raising the curve of the directional baffle type loudspeaker. (See later discussion under "Efficiency.") A



Figure 1

* A paper read at S. M. P. E. Spring Meeting, 1930.

[1] Wolff and Ringel: "Loudspeaker Testing Methods," *Proc. Inst. Radio Eng.* (May, 1927).

careful study of these curves enables us to make a competent comparison between the two types of speakers as regards frequency range, uniformity of response, and efficiency.

Frequency Range and Uniformity of Response.—It is immediately evident that the frequency range of the directional baffle type speaker is greater at both the low and high ends of the scale. The cut-off frequencies of the directional baffle type speaker are about 85 cycles and 6,000 cycles at the low and high ends, respectively, whereas those of the horn type speaker are about 125 cycles and 5,000 cycles, respectively. Thus at the lower end of the frequency scale the directional baffle type speaker has a half octave greater frequency range than the horn type and about 1/5 octave more at the higher end.

As regards uniformity of response, the directional baffle type of speaker obviously has the advantage. Between 300 and 5,000 cycles the response of the directional baffle type is slightly more irregular, but between these limits the variations in the response of the horn type are greater. Below 300 cycles, however, the horn type speaker is appreciably less responsive than the directional baffle type.

In order to enable a fair comparison to be made between the frequency response characteristics of the two types of speakers, the response curve of the directional baffle speaker was raised 7 decibels. In order to determine the relative average efficiencies of the two types of speakers the curve for the directional baffle type speaker was placed at its proper level, and the average response between its cut-off limits (90 and 6,000 cycles), determined by means of a planimeter. The result obtained is 16.6 decibels. The average response of the horn type loudspeaker for the same input power and between the same limits is 18.3 decibels. The average straight-ahead response of the horn type loudspeaker is thus 2.7 decibels greater than that of the directional baffle type loudspeaker for the same power input. This corresponds to a power efficiency ratio of 1.9 to 1.0. This difference corresponds to between 1 and 2 steps on the average gain control and is consequently of minor importance.

Distribution Characteristics

The radiation distribution characteristics of both types of speakers as now used are sufficiently good to yield satisfactory results. These distribution characteristics are fairly uniform through angles of about 20 degrees to each side of the normal to the mouth opening. In the average size of theatre this is sufficient. In wider and larger houses, two or more speakers may be used, thus securing good directional characteristics as well as permitting an increase in the total amount of radiation as required by the larger size of the house.

No accurate measurements were made with respect to input power capacity. However, it has been our observation that similar houses require the same number of speakers of either type for satisfactory sound reproduction. This indicates that, in view of the somewhat greater efficiency of the horn type of speaker, the directional baffle speaker type has the edge in respect to input power capacity. This is what might be expected from the fact that the radiating surface of the directional baffle type speaker, *i. e.*, a cone, is much sturdier than the fragile metal diaphragm of the horn type speaker.

It is exceedingly interesting to compare the results obtained with both types of speakers on listening tests in theatres and see to what extent these results are explainable on the basis of the measurements described above.

Tonal Qualities

Comparisons of this sort must be made separately for both speech and music.

If, in the reproduction of speech, we fix our attention upon the *understandability* only, we find that each of the loudspeakers is equally good. However, although speech on each of these speakers is equally understandable, the reproduction on the directional baffle type speaker is far more *natural* than on the horn type speaker. Reproduction on the horn type speaker has an unnatural quality. All voices sound very much alike whether of the same or opposite sex. Looking away from the screen makes it sometimes difficult to distinguish sex, except from the context. Male voices, particularly, sound too high pitched and unnatural.

These results are easily explainable on the basis of obtained frequency characteristics. It is well known that the elimination of all frequencies below 300 cycles and above 4,000 cycles exerts a negligible effect upon the understandability of speech. Since, on the whole, the response of the two speakers between these limits is the same, we would expect the understandability to be the same. This is what is actually observed.

However, the characteristic frequencies of the speaking voice lie below 300 cycles. They center around 125 cycles for the male voice and around 250 cycles for the female voice. It is these "fundamental" frequencies which give to each speaking voice its individuality and distinctiveness. A lack or deficiency of the frequencies below 300 cycles will rob the voice of these characteristics. This accounts for the superiority in naturalness of speech reproduction on the directional baffle type loudspeaker. The response of the directional baffle type speaker, between 100 and 300 cycles, is considerably greater than that of the horn type speaker between the same limits. This is particularly true below 140 cycles. Around 100 cycles the difference in response is around 12 decibels.

The reproduction of music is also adversely affected by the deficiency in the response below 300 cycles. Music reproduced on a horn type speaker lacks the fullness and depth apparent in the reproduction by the directional baffle type speaker. The complete reproduction of the lower register instruments is impossible on the horn type speaker. The result is that music loses its real quality and retains merely its melody. This is particularly true for music of a symphonic nature.

Horn vs. Cone Types

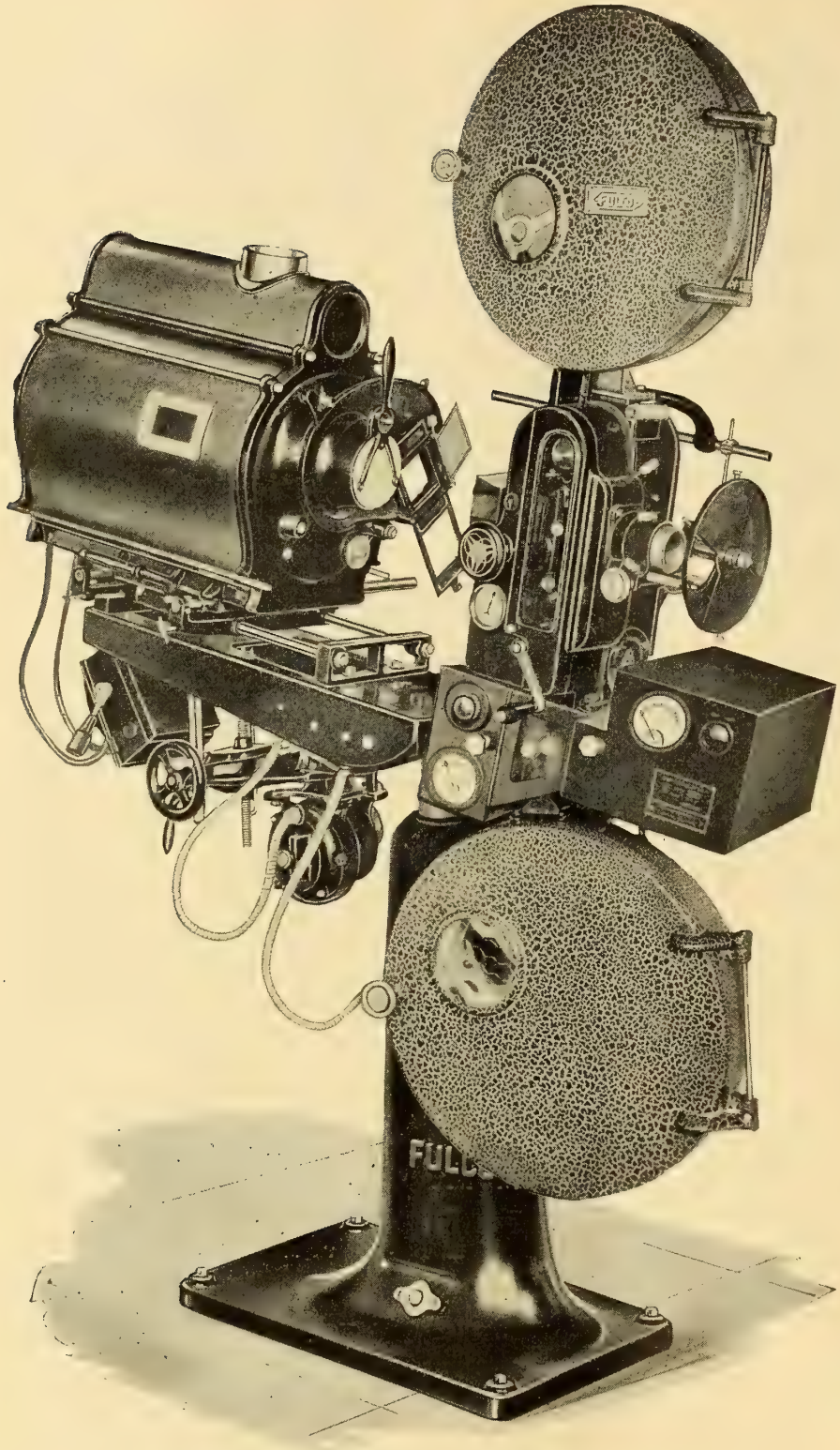
In a recent paper[2] certain statements are made in a discussion of horn and cone (or baffle) type speakers. The cone (or baffle) type speakers referred to in that paper are of a type wherein cones are set in a flat baffle, a type which is much less widely used than the directional baffle type speakers. Some of the claims made for the horn type loudspeaker are not borne out by our experiments. Thus it is claimed that the horn type loudspeaker and flat baffle type of loudspeaker are equally satisfactory as regards frequency characteristics. This may be true in theory but tests of actual devices as used in commercial practice show that the upper and lower cut-off frequencies of the flat baffle type of loudspeaker, which coincide approximately with those of the directional baffle type using the same cone, are much more widely separated than those of the horn type loudspeakers.

In addition the claim for power efficiency ratio of the horn type speaker to flat baffle type of 10 to 1 refers to a single cone in a flat baffle. In practice cones are never used this way in theatres, being either used in multiple on a flat baffle or, as is commonly the case, being set in a directional baffle. Either of these setups results in a marked increase of efficiency. A comparison of a horn type speaker with a single cone is thus not representative of the relative characteristics of standard apparatus.

The radiation resistance characteristic shown for a horn type loudspeaker with a 50 cycle cut-off is not typical of the horns employed in practice. The construction of a horn with so low a cut-off is very expensive and the size of the horn would probably be such as to make it too large for the average theatre. Aside from these considerations, the smooth cut-off shown is attainable only with an infinitely long horn, that is, attainable only with the unattainable. The frequency characteristic of a finite horn always exhibits horn resonances such as those which appear on the actual horn characteristic. In addi-

[2] Blattner and Bostwick: "Loudspeakers for Use in Theatres," *J. Soc. Mot. Pict. Eng.*, XIV (Feb., 1930), No. 2, p. 151.

(*Continued on page* 40)



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The Anatomy of Color

By V. A. SCHOENBERG*

The composition of color, why and how we see it is discussed in the accompanying highly interesting article on the anatomy of color. Color in itself has manifold applications, and its possibilities when coupled with the electronic art are limitless. This article forecasts the union of these two arts in a new and glorious addition to entertainment facilities.

THIS is a story about color, one of the most beautiful things Nature bestowed upon mankind, and yet so little understood. Color—beautiful, pleasing to the eye—is as well vitally necessary to practically all industries. Color, light, sound, and electronics have relationship in some form or other. Color and electronics combined with light offer some very interesting and practical applications. Color—but what is color? . . . Light, shade, and color are building steps of our visual reception of the world around us.

Natural objects reflect, absorb, or transmit light that emanates around us. Natural objects also reflect, absorb, or transmit light that emanates around them. It is surface, contour, or position or path and direction and degree of illumination which produce highlight and shades. It is a variation of brightness or tones of different parts of the objects and the sensitiveness of the retina which makes the objects visible as separate entities. It has wave length and frequency and can be separated or blended. The retina of the eye is proportionately sensitive to object brightness within fairly wide limits of illumination. This is due to the fact that the eye is capable to a certain extent through pupilary expansion and the sensitivity of the retina to adapt itself to various degrees of general illumination or adaption level.

We have always regarded colors as either bright colors or dark colors. For example: A bed of tulips of many hues, the flowers of the blue variety seem to be relatively dark and somber, but the flowers of yellow and red seem to be extremely bright and luminous. Then it is asked, "Why do some objects appear to be colored while others are free from color?"

Composition of Colors

White light, whether it be artificial or natural daylight, is composed of an intimate mixture of violet, blue, green, yellow, orange, and red light. When this beam of white light is passed through a prism, it is then split up into component parts and all of the above mentioned color constituents appear. And again, if all of the color constituents are again combined by the aid of a prism, then, once more, the color is white.

It is possible that any of the colors met with in nature can be imitated by mixing the proper preparation of two or more of the three primary lights (not pigments), of blue, green, and red light. Then if it is illuminated by daylight, or artificial white light, and reflects towards the eye of an observer, most of the light reflected is white, because it reflects so high a proportion of the illuminating light. Then why is it not colored? It is not colored because it is bathed in the white light, blue plus green, plus red, and reflects all the color constituents of white light in equal proportion, and leaving them still intimately mixed which gives to the eye the sensation of white.

Light Reflective Qualities

Again, a grey object differs from a white object only in the amount of white light reflected, as the grey object may only reflect ¼ or ½ of the white light which falls upon it. Hence, its greyness or lack of brightness compared with the white object. But the white light, which it does reflect although deficient in quantity is the same in quality as the white with which the grey object was bathed, and is an intimate mixture of blue, green and red light.

Then again a black object reflects a very small proportion of the white light with which it is illuminated, but the white light which it does reflect is still an intimate mixture of equal proportions of blue, green, and red light. It is then seen that white, grey and black objects differ from one another only in the amount of white light which they reflect, and this reflected light is still an intimate mixture of blue, green, and red light.

Why We "See" Colors

A blue object is blue because it reflects the blue constituent and absorbs the red and green constituents of the white light. The white light following upon a blue object is partly reflected and partly absorbed. The absorption is chiefly confined to the green and red constituent, and the reflected light is chiefly the blue constituent of white light. The light reaching the eye via the blue object is for the most part blue light and is markedly different in green and red light.

A green object is green because it reflects green light but absorbs blue and red light. Then the light that reaches the eye via a green object is white light, blue plus green, plus red from which the blue and red constituents have been absorbed, and only the remaining constituents of white light—green light—is reflected.

A red object is red because it absorbs the blue and green constituents of white light and only reflects the red constitutents, which to the eye of the observer gives the sensation of red light.

An important color of light is yellow. When green and red light are mixed, a brilliant yellow is produced, and when so produced and analyzed with a prism, green and red once more are seen.

A yellow object, therefore, is one which when illuminated with white light, absorbs the blue constituents of the white beam and reflects the green and red constituents, which mixture, upon reaching the eye, gives the sensation of yellow light.

Electronic Tube Application

The brightness exhibited by the color objects depends upon the sensitiveness of the eye to the color light which the object reflects, and the amount of color light reflected. It is thus that the photoelectric cell and electronic tube can play an important part in the selection, grading, etc., of colors.

Scenic artists in designing stage effects take advantage of the sensitiveness of the eye by use of color lighting. By proper blending and mixing of colored light, pictures can be produced that are not visible to the eye until a certain colored illuminator is employed, such as a man or horse, or an automobile, or any other object. But when the lighting effect is changed, various other objects appear, such as, perhaps, trees, and a complete landscape, etc.

Television in Color

In television, color offers some complex problems but the electronic tube helps to solve it. In the steel industry, color is important and the road can be lightened by the use of the electronic tube.

Thus, it is seen that color, light, sound, and the electronic tube have an intimate relationship and, when properly employed, can lighten the burden of mankind. Then why not use to advantage that which Nature gave us?

* Engineering Dept., Enterprise Optical Mfg. Co.

Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

DON'T guess at troubles with sound equipment. The method of testing for sound in the movietone mechanism and also the magnetic reproducer is the same with all systems. I have found many projectionists who have the habit of threading the sound projector mechanism for the mere fact of finding out if the Movietone sound system was functioning. This is a waste of time, as it is very easy to check Movietone by passing your finger quickly up and down through the light flux, with the light gate removed, entering the photoelectric cell, with all meters set at their operating values and the fader on normal setting. A thump will be perceptible at each interruption in the light path during this test which will be proof that the Movietone system is functioning properly.

I have noticed projectionists testing the Movietone system by touching the positive lead of the photoelectric cell, and after hearing the crackling noise they would assume that the system was functioning properly. If this method of testing is used some time or other the photoelectric cell may be dead, and when starting the projector it will be found that no sound is coming from the Movietone unit.

Most tests have their limitations. Projectionists and engineers will find that interrupting the light source entering the photoelectric cell is the best and quickest method for testing for sound with Movietone. The importance of making tests before the show starts cannot be overemphasized.

Balancing Projectors

It is important, however, that both projectors be balanced equally for sound reproduction. If they are not, the level of sound will be disturbed when changing from one projector to another. To meet this situation with Movietone, the Western Electric have in use, with their sound projector system, what is called a 701-A apparatus unit, which is a small block in the case supporting the 49-A amplifier. This block is called the attenuator. It has a series of resistances connected in the shape of a T, and also a series of steps with a connecting link between resistances, which introduce different losses increasing in 3 db steps.

The top part of the attenuator is used for the purpose of balancing the energy level of both projectors, which has nine steps, with connecting links. The first step on top of the attenuator is 6 db and the remainder is in steps of 3 db each.

Photoelectric cells differ in energy output and therefore it is necessary to equally balance both projectors by changing the taps on the attenuator. The fader steps are 3 db each. Usually the projectionist can tell by the setting on the fader how much lower or higher one projector is than the other by running film with the same sound track on both projectors, and by turning the fader from the red to the white projector and vice versa.

One of the best methods for balancing Movietone projectors is to use endless loops, which can be very easily threaded and removed. When using the endless loop for this purpose, it is only necessary to thread the Movietone mechanism. It will be found that by using the endless loop for this purpose checking the energy level can be done much quicker and more satisfactorily.

The lower part of the attenuator is used for providing a means for balancing disc reproduction as compared to the film. The attenuator is not connected in the disc circuit. It is connected in film pick-up amplifier circuit only. Usually the film reproduction level is higher than the disc. There are three steps on the lower part of the film attenuator of 3 db each. We term the lower part of this attenuator as the machine attenuator as it takes care of balancing the energy level between the disc and film. Each individual Western Electric sound projector has its own attenuator.

Volume Changes

It will be found that certain places in the Western Electric System where it is possible to change the volume that changes occur in steps of 3 db. Some engineers claim that a change of 3 db in volume is not perceptible in the auditorium. As proof that it is, increase or decrease the fader one point, which has 15 steps of 3 db. This will give you a definite idea how much volume 3 db is.

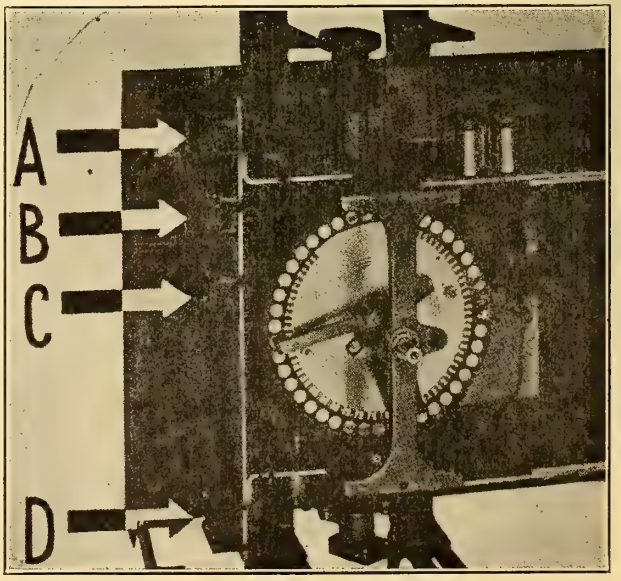
W. E. Fader

The Western Electric Fader has given us very little trouble. However, one of the things which has occurred has been that one-half of the fader would short out, leaving the one projector without means of controlling the volume. The output from each projector runs to the fader. If one side of the fader should short out, it is possible to change the output over to the other side of the fader and run both projector outputs to one side of the fader. If this expedient hook-up is made, it is very important that the fader be brought to zero on changeovers.

Function of Fader

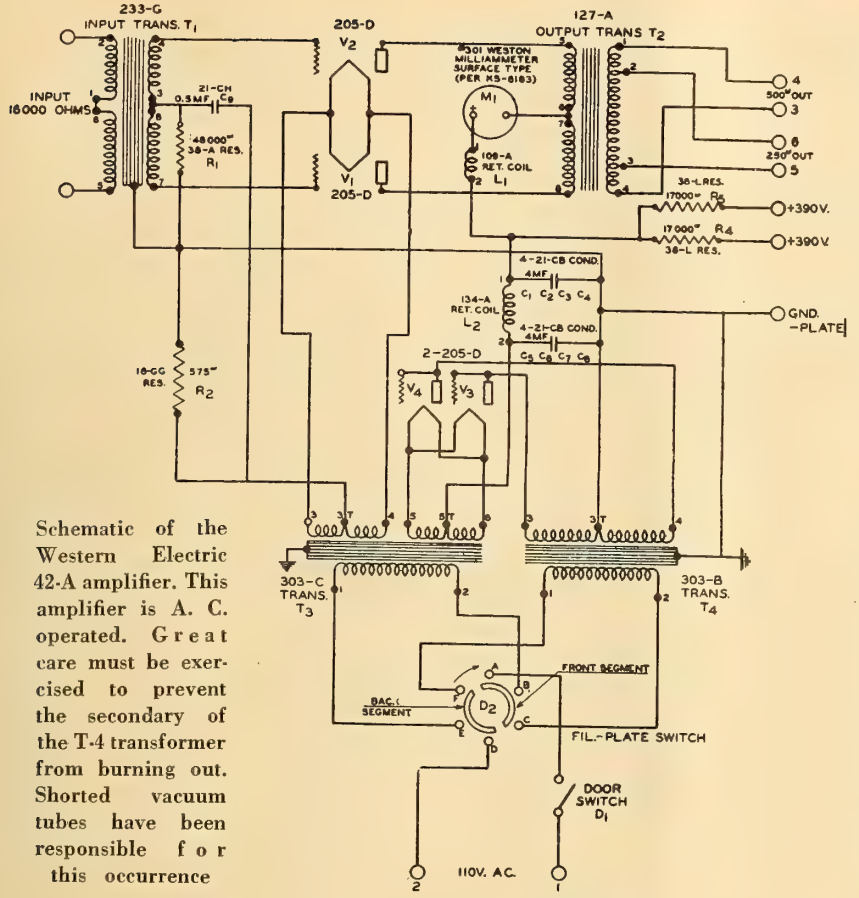
The Western Electric fader plays three important parts. First, it is used for making changeovers from one projector to another. As you get to the end of the reel the fader is brought down on the out-going projector, which diminishes the sound to zero and the sound on the incoming projector is brought up to the same volume level as the outgoing projector. If the fader is handled properly, the entire operation is done so quickly that it is not perceptible in the auditorium.

The second important part which the fader plays is controlling the volume. The third use of the fader is for matching impedances. It is



W. E. Fader

Terminal blocks marked A, B, C are output connections from projectors; D is output to Screen Amplifier. If one side of the fader should short out, leaving one projector without means of controlling the volume—the outputs could be connected to the good side of the fader, and this one side of the fader could be used for both projectors



Schematic of the Western Electric 42-A amplifier. This amplifier is A. C. operated. Great care must be exercised to prevent the secondary of the T-4 transformer from burning out. Shorted vacuum tubes have been responsible for this occurrence

quite evident that the output of the 49-A amplifier does not have the same impedance as the input of the 41-A amplifier, which is a speech amplifier. If the output impedance of one amplifier is different than the input impedance of the preceding amplifier, it is necessary to insert some form of apparatus or series of resistances to match up the impedance. The fader plays this part.

It is quite true that in any electrical circuit, the most efficient transfer of energy between two pieces of apparatus gives more efficiency if the impedance is equal.

Fader Contacts

Fader contacts must be inspected quite frequently, cleaned with carbona, polished with a good grade of fine paper and lubricated very slightly with vaseline. Dirty fader contacts are very noticeable in the form of popping and crackling noises when changeovers are made or when increasing or decreasing the volume.

Exciting Lamp

The current operating value for exciting lamps is 3.9 amperes, 8 volts. I have found many ammeters in series with the exciting lamp circuit to indicate the wrong value, and the lamps would be operating above their values, which would shorten the life of the lamps and besides the volume level of the two projectors would be unbalanced. It is extremely important that you verify the reading of the ammeter connected in the exciting lamp circuit and be positively sure that the ammeter is registering correctly.

Have you ever sat in a theatre watching a picture and listening to the sound, and when a change-over was made, the sound did not come through? The projectionist would finally wake up and find out he forgot something, and with the fader on the auditorium level point, would then close the circuit, which he forgot and a loud blasting noise would come from the horns, which would make patrons rise from their seats. This has happened in many theatres.

Careful Check Necessary

It is imperative to check everything there is to be checked before starting the projector. Be positively sure everything is O. K.

I mentioned during one of the last articles that the switch controlling the exciting lamp circuit and photo-electric cell amplifier should remain on at all times during the performance, but the values should be reduced. Turning on and off this switch causes a popping noise, which is very annoying, and besides it may happen where it will spoil spoken work in the reproduction. The sound picture performance must run smoothly and without extraneous noises.

Maintenance

Common sense is still requisite for the installation, operation and maintenance of power amplification systems. In addition to this, the more data secured and time spent on study of the particular apparatus you are operating will assist greatly in making quick repairs in case of an interruption. You cannot always rely on the service engineer, as his territory covers many miles, and during the time when he is many miles away from your theatre something might happen. You should be capable of taking care of any trouble. Perfect operation must be the goal of all sound equipments. The sound installation with an inoperative power amplifier is embarrassing to you as well as being a financial loss to the theatre.

Capacity

Capacity is the ability or power of anything to receive or to contain electricity. The capacity of a condenser or other device is the amount of electricity or the electric charge that it will receive and hold. The unit of measurement for capacity is the farad, but capacities used in amplifier circuits are so small that the practical unit in this field is the microfarad which is one-millionth of a farad.

A condenser which will receive and hold one coulomb of electricity when a pressure of one volt is applied to its terminals has a capacity of one farad.

41- and 42-A Amplifiers

THE 42-A W. E. amplifier includes a rectifier, which supplies potential to the plate circuits of the 41-A and 42-A amplifiers. The T-3 transformer on the 42-A amplifier supplies filament current for the two 205-D amplifier tubes and the two 205-D rectifier tubes. The T-3 transformer very seldom gives any trouble. The secondary of T-4 transformer has burned out on a few occasions. This transformer supplies plate potential for the rectifier tubes V-4 and V-5, which is a full-wave rectifier. If the secondary of T-4 transformer burns out, the plate potential for the 41-A and 42-A amplifiers will be cut off immediately. On many occasions theatres have closed down and have refunded admissions, because they could not secure another transformer or another amplifier.

If you encounter this trouble, the following temporary hook-up can be made, which will supply plate potential to the 41-A and 42-A amplifiers and you can continue operation of your sound equipment. Secure from the nearest radio store nine 45-volt dry B batteries. Connect these batteries in series so that 400 volts may be obtained.

Disconnect lead No. 2 on the 109-A retardation coil. This temporarily disconnects retardation coil No. 134-A and also filter condensers, C1, C2, C3, C4, C5, C6, C7, and C8. Connect the 400-volt positive lead from dry B battery circuit to terminal No. 2 on retardation coil No. 109-A. Connect the negative lead of the 400-volt

dry B battery circuit to ground. You may now continue operation.

Be positively sure when operating with this hook-up that the amplifier starting switch is turned to filament and not to plate. The 41-A and 42-A amplifiers are now receiving plate potential. It should be noted that the 205-D tubes in the 42-A amplifier are placed in a horizontal position. When vacuum tubes get old and their filaments start to sag it is best to discard them in a short time; otherwise, they are liable to cause an internal short circuit in the tube, which will burn out the secondary of one of the power transformers.

Condenser Microphones

I have been asked to explain the action of a condenser-type microphone. The condenser-type microphone converts sound into electrical energy with practically no distortion or accompanying hissing sounds which are characteristic of the carbon-type. Probably the only disadvantage of the condenser-type is that more stages of amplification are required to reach a satisfactory so-called noise level or volume level.

The condenser type is constructed with a tightly stretched thin metal diaphragm and mounted close to a heavy metal plate which serves as the second plate of the condenser. The air film between the diaphragm and the metal plate is the dielectric, and it acts to dampen the vibrations of the diaphragm so that the diaphragm will not set up independent vibrations of its own and actuate certain frequencies more than others. A battery of a few hundred volts is employed to set up the electrostatic capacity between the plates and the feeble voltage changes produced by the condenser when its changes in capacity are delivered as a fluctuating voltage to the grid of the first stage amplifier tube.

A. C. Hum

I was asked the question just recently—what the difference was between A. C. filament tube and direct current vacuum tube. The A. C. tube has the same operating characteristics as corresponding types of direct current tubes so far as plate and grid circuits are concerned. The tube is similar in appearance and in general construction to direct current tubes designed for similar purposes. The sole difference is in the filament.

The chief problem in designing A. C. filament tubes is to reduce the tendency for carrying the alternating current hum into the plate and grid circuits. There are several reasons for this hum. First, there is the rise and fall of temperature as the alternating current rises from zero to maximum and then falls again. This changes the rate of emission of the filament at twice the frequency of the heating current.

Second, there is the effect of the high voltage end of the filament on the low voltage end as first one end is at a positive voltage and then at a negative voltage with respect to the other. Here electron flow changes with the relative voltages of different parts of the filament due to rise and fall of current through the filament just as there is radiation from any conductor in which the current is changing.

Filament Proportions

The rise and fall of temperature is minimized by making the filament of such proportions and of such material that its heat changes slowly. It heats slowly and because of a low rate of heat dissipation, cools slowly. This calls for a filament of large cross section and a material furnishing a plentiful electron emission at low temperatures. Many of these filaments are of the oxide coated type for the latter reason.

The effect of voltage difference in the filament is minimized by keeping the ends well separated or by using a long, straight filament and by operating it at voltages low enough so that the difference between maximum and zero voltage is not great. In still other designs the radiation problem is handled by using a comparatively high voltage with a correspondingly low current.

Battery Care

When a battery is charging, hydrogen gas is liberated, especially at the end of the charge. This gas fills the space in the cells above the electrolyte. It is highly inflammable, and if ignited, may cause considerable damage. A flashlight or an electric lamp on an extension cord should always be used rather than to take a chance with a match.

Overheating of a battery may be caused by too heavy a rate of charging, by insufficient electrolyte, or by internal short circuits in the cells. The plates become buckled or broken, and this may in turn cause the insulators to break, permitting adjacent plates to touch each other, which also causes a short circuit. Besides warping the plates, overheating may cause the material on the plates to shed and drop away from the grids. Furthermore, overheating causes the electrolyte to get hot, which results in excessive sulphation of plates and also causes the electrolyte to evaporate quickly, resulting in a low level.

Corrosion

Corrosion, which collects on the battery terminals, especially on the positive terminal, destroys within a short time the leads connected to it. This corrosion copper sulphate is either a green-colored paste or a chalky substance. To prevent corrosion from accumulating, the battery terminals should be carefully cleaned at regular intervals with a solution of ammonia and water, or a solution of ordinary baking soda and water in the proportion of one tablespoonful of soda to every 3 oz. of water. After the terminals have been wiped clean and dry, a coating of vaseline or ordinary cup grease should be applied. This coating will prevent subsequent corrosion. Do not apply the vaseline or grease to the terminals while the leads are disconnected, for after replacing them, it will be found that the grease is also an effective insulator, which prevents a good electrical contact of the wires to the battery terminals, with the result that no current can be obtained.

Corroded leads on storage batteries generally make poor contact, forming a high resistance joint, which may cause crackling noises in the reproduction.

707-A Drive

Many interruptions have occurred due to the stripping of the fiber gear on the 707-A drive, on the W. E. universal base. I am surprised that so many projectionists have overlooked the reason for stripping this gear. The foot brake on the universal base is only to be used in case of an extreme emergency. It is very important that the foot brake be set so that it will stop the projector mechanism gradually instead of a dead quick stop.

Stopping the projector quickly is the direct cause for so many fiber gears stripping. When the projectionist first enters the projection room, prior to starting the performance, both projectors should be run for a short time, prior to being threaded. They should be run slowly. This will give the bearings a chance to loosen up and run free, before giving them top speed. Always use light oil in projector bearings.

The most recent W. E. power amplifiers are A. C. operated. I have answered a number of calls in regard to the short life of power amplifier and rectifier tubes. In order to obtain full life from tubes operating on A. C., the filament terminal voltage should not exceed that specified by the manufacturer. In appreciation of the fact that the filaments are often overloaded when the incoming voltages from the A. C. lighting mains rise above the point of safety, a means must be provided for controlling the input voltage to the rectifying transformer.

It is necessary to check the incoming voltage with an A. C. recording voltmeter. If the voltage is far above normal, it will be up to the local power company to correct this condition, by installing a voltage regulator. With systems using the 41-A, 42-A and 43-A amplifiers, the plate current is indicated by a plate current meter on the 42-A and 43-A amplifiers. The plate current indicated value should stay within the red limits on these meters. With an increase in line voltage, these indicated values will pass the red mark on the plate current meter, and if this increase in voltage continues, it is liable to break down the insulation on one of the condensers.

Recording Technic for Sound Pictures

By J. P. MAXFIELD

THE technic of acoustic control is based on letting the camera be the eye and the microphone be the ear of an imaginary person viewing the scene. It might be interesting, therefore, to consider briefly how a person observes, that is, how he sees and hears what is taking place around him. When a person is viewing a real scene in real life, he is viewing it with lenses—that is, the eyes—and the pick-up devices—that is, the ears, which are in a fixed relationship, one to the other. This observer is equipped with two eyes and two ears. The two eyes enable him to appreciate distance or depth with much more facility than would be possible with one eye, while the two ears enable him to appreciate direction and perhaps, to a slight extent, depth where sound is concerned. The point of importance, however, is the fact that the eyes and ears maintain a fixed relationship to one another.

The method by which direction is determined with either one or two eyes is obvious and need not be discussed. The factors which enter into the appreciation of depths or perspective of sound are the ones of interest here.

Relative Loudness Changes

It is probable that the most important factor, particularly where monaural hearing is concerned, is that which deals with the relative change in loudness of the direct and reflected sound. Since the intensity of the reflected sound varies relatively little from place to place in a room, while the direct sound from the sources to the pickup device varies quite rapidly with its distance, the ratio of the intensity of the direct to the reflected sound also varies considerably. Hence, as a source of sound, such as a person speaking, recedes from the microphone the loudness of the voice appears to decrease slightly while the reverberation appears to increase materially. With binaural listening, this is unconsciously interpreted as distance. It has been found that this effect, when properly controlled, is also interpreted as distance with monaural listening.

In the case of the talking pictures, the camera has only one eye, or lens, and the recording system has only one ear or pickup device. Consequently those effects, which were brought about by the binocular seeing and by binaural hearing, cannot be made use of. Long experience with the photography has enabled the cameraman to create a part of the depth illusion by the proper choice of the focal length of the lens used, and by the proper type of lighting.

Good sound reproduction in the theatre is possible only if a given print has been given the benefit of efficient recording. The accompanying article by J. P. Maxfield, a contribution to the Technical Digest of the Academy of M. P. Arts and Sciences, is of particular interest to projectionists, as it sets forth some of the difficulties to be overcome before a good recording may be had. Mr. Maxfield is particularly qualified to discuss this important subject. His recording of "Memories," sound film short, for which only a single microphone was used to record an orchestra of 125 men, is considered to be one of the finest film recordings ever made.

Fortunately, for the acoustic engineer, the impression of depth depends upon factors which are almost as effective with binaural listening: namely, the change in the ratio of the direct sound to the reverberation present.

The Sense of Direction

The loss of direction, brought about by the use of one ear only, causes some rather unexpected results. When two ears are used, a person has the ability to consciously pay attention to sounds coming from a given direction, to the partial exclusion of sounds coming from other directions. With the loss of sense of direction, which accompanies the use of the monaural hearing, this conscious discrimination becomes much more difficult, and the incidental noises occurring in the scene, as well as any reverberation which may be present, are apparently increased to such an extent that they unduly intrude themselves on the hearer's notice. It is, therefore, necessary to hold the reverberation, including these noises, down to a lower loudness than normal, if a scene recorded monaurally is to satisfactorily create the illusion of reality, when listened to binaurally.

This apparent increase in reverberation and incidental noises may easily be heard, by completely stopping up one ear and listening with the other only. It is easier to detect the effect in a room, where the incidental noises are fairly loud, and where the amount of damping is slightly less than in the normal living room.

Microphone Placement

Since it is possible to create the illusion of depth or distance in both the visual and audible parts of the talking picture, it is necessary that the amount by which the voice appears to move forward and backward in the set, should correspond with the amount the image appears to move. The amount by which the voice appears to move forward and backward in the set, depends upon the amount of reverberation present, and upon the relative distance of the microphone from the foreground and background action. In general, the more reverberation present, or the further the microphone from the source of sound, the greater is the apparent distance of the voice from the near foreground. It has also been found by experience, that if the conditions have been made correct to obtain this illusion, then the voice or sound also appears to follow the picture across the screen.

There is one important difference between the imaginary observer in the scene and the taking of a talking picture. The real observer maintains his pickup device, namely ears, at the same distance from the scene as his lenses, that is, eyes. This is not necessarily the case with the talking pictures, as the cameraman may, at will, use lenses of different focal lengths, whereas the observer cannot change the focal length of his eyes beyond that amount required to accommodate focus.

The use of long focus lenses by the cameraman is equivalent to a means of bringing distant action into the near foreground. When such action is brought into the near foreground by the use of the closeup, it is also necessary to pull the sound up, so that it appears to be coming from a similar distance, that is from the image on the screen.

There is one other point to be kept in mind regarding the analogy between the imaginary observer and the talking picture equipment. If a speaker in the scene walks away from the imaginary observer, he walks away from both his eyes and his ears. It is, therefore, necessary to place the microphone in the same approximate direction from the action as the camera, in order that the speaker shall approach the microphone when approaching the camera and vice versa.

Single "Mike" Preferable

In view of the above, it cannot be too strongly stressed that it is important to use one microphone only for a given camera position. Naturally if the camera position changes during the scene, the microphone position should change accordingly, so that the proper relation be-

(*Continued on page* 39)

As The EDITOR Sees IT

¶ *The Industry's Wide Film Bill*

MANY estimates of the cost to the industry of changing from 35 mm. to a wider standard film have been made, but $25,000,000 represent the consensus of opinion on the subject among film company executives. While there is no means for checking the accuracy of these figures, we may be sure that the bill in any final reckoning will be at least that much. A significant feature of this advance cost analysis is the fact that slightly more than two-thirds of this sum will be charged against the exhibition end of the business—against the theatres. The possibilities of such happy days must be especially cheering to the equipment people—yet they should not forget that no company will get its share of the business unless it can show both quality and price. The contemplated change in standards really is a challenge to the equipment men, and we look for them to outdo themselves in improving their products.

Thoughts of wide film lead us to thoughts of television—inevitably. For if the industry is to embrace wide film as the next logical advance beyond sound pictures, should not preparations be made now for immediately thereafter making another change to accommodate television, with its promise of a radically new technique? We think not. For it is one sure thing that the industry will not now spend $25,000,000 for a change in standards if it is to be faced with the prospect of a far greater expenditure after only a few years.

To us, at least, the answer is plain. If television is lurking "just around the corner,"—and we are assured daily that it is—then we may be sure that wide film will be promptly forgotten. In fact, the motion picture industry's estimation of the immediate prospects of television will be shown in the speed with which it moves to introduce wide film.

Dr. Alexanderson's recent television demonstration at Schenectady was very impressive as an indication of the progress made in this field, but the widespread publicity accorded the work, plus a great deal of injudicious comment by writers totally unfamiliar with the art, made the test (which is just what the work involved), appear as either a re-invention of the art or the "last word" on the subject.

We are not at all bearish on television. On the contrary, we are more than pleased to record its steady progress. But when a wave of misguided publicity lets loose a torrent of "scare" discussion within the industry, we feel impelled to set down our honest opinion on the matter.

¶ *The 30th Convention*

THE International Alliance made a splendid showing at its 30th Convention just ended in Los Angeles. Particularly gratifying was the re-election of William F. Canavan as President of the organization for another two years. This in itself was a good day's work. From start to finish the Convention was a grand and glorious success—the business sessions, the sectional meetings, and the entertainment provided.

We can't let pass the opportunity of paying tribute to the five Los Angeles units which did the work that made the Convention the great success it was—Local Unions 33, 37, 150, 683 and 659. From start to finish, from putting on "The Biggest Show on Earth" right down to providing those little personal conveniences for the delegates, these five Local Unions did yeoman deeds. Every member of the I. A. is indebted to these men for their work.

¶ *Print Condition*

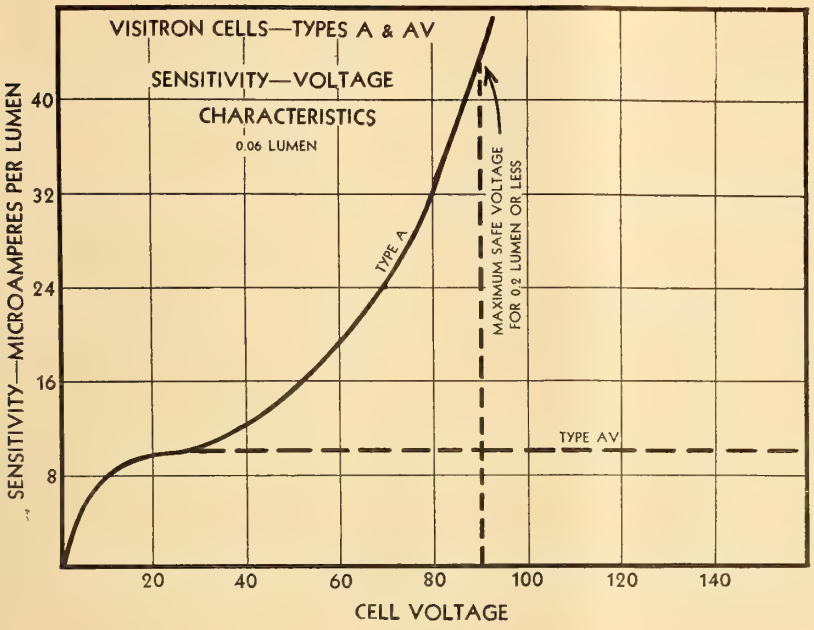
THE film industry has many pressing problems not the least important of which is that of bad film conditions. The while a constant buzzing is going on about sound pictures, color, television, mergers, etc., not a word is uttered about one of the industry's most pressing problems, the solution of which would save thousands of dollars for producers and as many more thousands for exhibitors within a year's time.

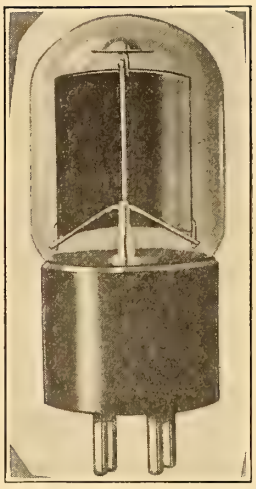
Films continue to be shipped out on single reels, despite the proven fallacy of such a procedure; cue sheets are very often omitted, thus extending an invitation to the projectionist to cue his film as he sees fit; the inspection accorded film in the exchanges is perfunctory at best, and many other details in care and handling are overlooked—all because the problem has never been properly presented to those who best are in positions to do something about the matter.

Visit any projection room selected at random from a group of theatres other than the so-called de-luxe houses, and what does one find? The answer is that one finds film in such poor condition that it is a wonder how it even is run through the projector, much less give satisfactory results to sound and scene. But one will rarely, if ever, find such conditions prevailing in the projection rooms of the "de-luxe" theatres. Not at all. And why? Just because the "de-luxe" theatres have found from expensive experience that the best insurance of a good show is perfect prints. If sauce is good for the goose, why not for the gander?

Such conditions are shocking—particularly in an industry which prides itself on getting things done in businesslike fashion. Projectionists are partly to blame for this evil, but they certainly have lots of company in this respect.

Let the producers demonstrate that they can and will supply good prints, properly cued, to all theatres; then institute an assessment against the theatre from which mutilated prints are returned. Then, let the chips fly where they will. This problem demands immediate attention, and apparently only a drastic remedy will admit of correction.





Above: New type Visitron cell. At left: Fig. 1.

G-M's New Type Photo-Electric Cells

FROM the time that sound-on-film was introduced to the American theatre field, it has been generally realized that quality in photoelectric cells is of the greatest importance for good sound reproduction and continuity of service. To those engineers who have been responsible for the design and servicing of such equipment it has also been apparent that the cell—being the heart of the entire apparatus from which the undistorted electrical signal must originate—has not been as dependable nor as free from service difficulties as could be desired. In fact, it has been the opinion of many that, of all the large number of coordinated parts which make up the sound-on-film projector, the photo-electric cell has been one, at least, of the weakest links in the chain.

Since 1925 continuous and uninterrupted effort has been made to improve upon existing types of photoelectric cells. Today the new Visitrons, types A and AV, represent the culmination of much of this research and manufacturing experience.

Gas-Filled vs. Vacuum Cells

Electrically, Type A and Type AV cells have considerably greater current output and lower operating voltage than previous types of alkali metal photo-electric cells. Characteristic curves of the gas-filled (Type A), and vacuum (Type AV), cells are shown in Figures 1 and 2. The gas-filled type has from four to five times the sensitivity possessed by the vacuum cells, but requires more critical adjustment of operating voltage. Gas-filled cells are generally used for sound projection work; while vacuum cells are often used for quantitive measurement and relay purposes.

In sound motion picture work, it is customary to use a preliminary or "head" amplifier of the type shown in Figure 3. The output of this amplifier may be attenuated through the fader and then connected to the power amplifier of three or more stages terminating in the power tubes and theatre speakers. In designing such amplifiers it is desirable to provide sufficient voltage gain that the photoelectric cell may be operated at an output level below its maximum capacity.

When two sound projectors and two preliminary amplifiers are to be used with one fader and one power amplifier, it is customary to match the output of the cell in each projector to give the same output to the fader.

The recommended method in the case of the Type A cells is to adjust the cell voltage by means of a potentiometer. In all cases the cell voltage should be made as low as possible to obtain the most satisfactory results and the maximum cell life.

Replacement Requisites

To replace older types of cells in standard equipment with the new Type A cells it is generally only necessary to make the voltage adjustment mentioned above. In many installations a cell voltage potentiometer is not provided, in which case the voltage can be varied only by shifting the wires on the "B" battery

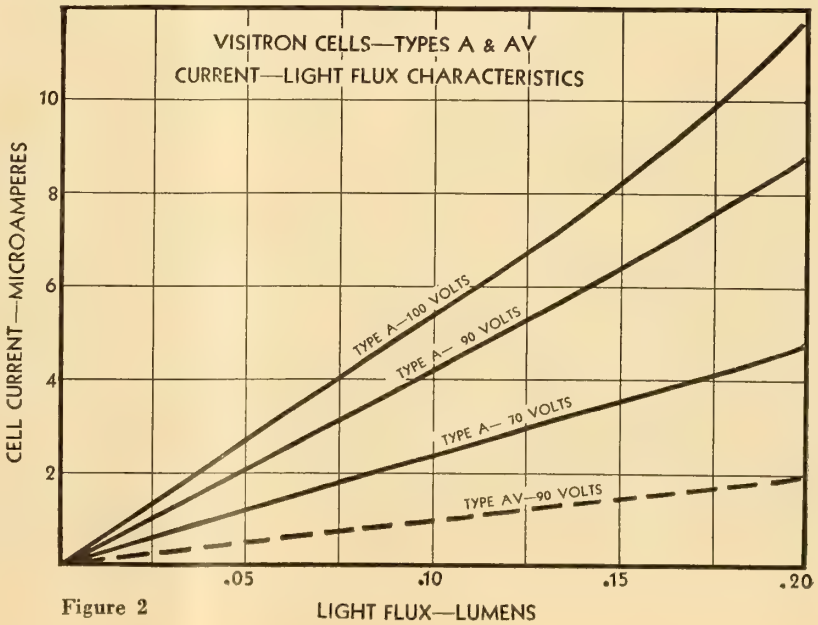


Figure 2

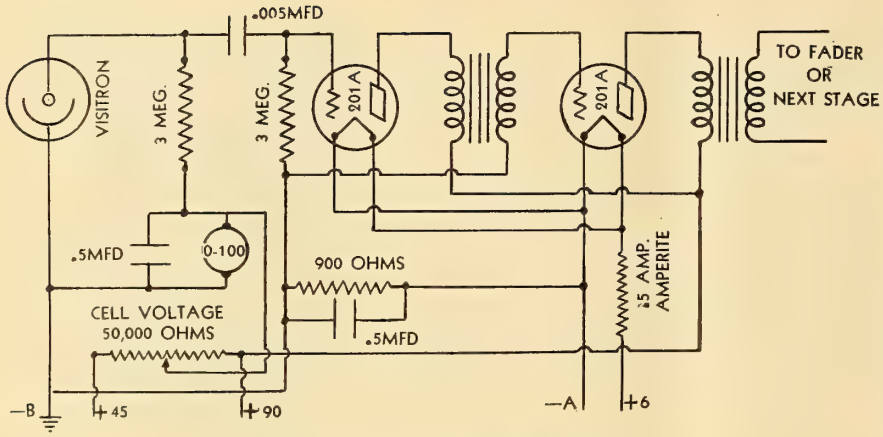


Fig. 1. Preliminary or "head" amplifier

taps. If small changes in voltage cannot be obtained in this way, it is advisable to procure a high resistance wire-wound potentiometer to connect between the 45- and 90-volt taps on the battery.

In making the adustment the voltage should be set at a low value and gradually increased until the normal input to the amplifier is obtained. If the high voltage applied to any gas-filled cell is raised to too high a value, its sensitive surface may be damaged. It is therefore advisable whenever installing a new photo-electric cell to start with a low voltage and increase it in small steps.

In general, the voltage required for the proper operation of the Type A Visitrons is not more than 90 volts.

The Multicolor Process

By W. T. CRESPINEL*

A SIMPLE method is utilized by the Multicolor process in obtaining results. Ordinarily, to produce a color value negative, complicated cameras using prisms and color filters have been employed. While not belittling these early attempts at photographing in color, they necessarily are a hindrance rather than an asset, particularly when photographing with electric lights.

Prisms and color filters, especially color filters, absorb a terrific amount of the light on a set. Consequently the absorption of light must be made up by an additional amount of light, which is not only uncomfortable to the actor, but has sometimes proved to be quite an injury.

No Prisms or Filters

By the Multicolor process an ordinary, standard, motion picture camera is used, without the use of prisms or color filters. Two films are run through the camera at normal speed, with their emulsions adjacent to each other, the front film photographing the colors of the blue-green end of the spectrum and the rear film recording the complementary colors. Consequently normal lighting, as used for black and white photography, is all that is necessary when photographing with Multicolor.

The method of obtaining color values is briefly as follows: Let us presume we are photographing a red rose with green leaves. The front negative, which is sensitive to the blue-green end of the spectrum, would only record the leaves of the flower, and since it is insensitive to red, the rose would not be recorded on this front negative. The rear negative would photograph or record only the rose itself, consequently, when the negative was developed, one negative would show a record of the leaves and stem, and the second negative a record of the rose.

Developing Process

Multicolor employs Eastman positive film, in which the emulsion is coated on both sides of a transparent base. The respective negatives are printed onto this positive film—one negative on one side and the second negative on the opposite side. The emulsion of this film carries a retardant dye which prevents the images, during the printing period, from penetrating to the opposite side of the film. The negatives are printed and then developed.

Consequently we now have on one side of the double-coated film, a positive image of the rose, and on the opposite side, a positive image of the leaves, so when looking through the film at some lighted object, we have a composite picture of the original object photographed, but in monochrome values. If the positive film did not have a retardant dye, in printing, the image of the rose would penetrate through to the second emulsion. Likewise, the image of the leaves would penetrate through to the opposite emulsion and degraded color values would result.

Coloring the Film

The film, as already explained, is developed and is ready for coloring. It is now placed onto the coloring units whereby a green color is applied to the side carrying the images of the leaves, and when the film has passed through this solution, the rose is still black and white, but the leaves are green. This image is then fixed to prevent further colorization by subsequent coloring baths.

Final Operation

The film then travels to the red coloring solution which does not affect the already colored green leaves, but does transpose the black and white image of the rose into its correct shade of red. The second image is then fixed and the operation of producing a colored positive is complete.

A sound track can be printed onto the film and colored with either of the basic colors and it will record sound in the theater with the same clarity as ordinary black and white film enabling an analysis of motion and miniatures with ease.

* Multicolor Films, Inc.

Questions and Answers —Manager Style

A questionnaire devised by the manager of a Fox West Coast Theatre has been answered in a manner which, while very unsatisfactory from a technical point of view, probably appeals to that sense of humor which is found in many people engaged in show business—particularly in theatre managers. The answers, incidentally, are said to have been made by a projectionist, but whether this is true cannot be ascertained at the moment. In any case, it looks very much like another one of those loads we projectionists have to bear. The truth probably is that the answers were made by a manager. Witness:

What is a "B" Amplifier?

A. One the exhibitor gets stung on.

What is a "Fader"?

A. The Head Man in a crap game.

What is "Service"?

A. A guy that writes poems about Alaska.

What is a "Lower Magazine"?

A. Whiz-Bang.

What is an "Ohm"?

A. A 'ome is an English 'ouse.

What is "Resistance"? Give an Example.

A. When a boy wants to kiss his sweetie and she won't let him. That's Resistance.

What is a "Charger"?

A. A Big White Horse.

What is "Speed Control"?

A. A Motor Cop.

"Out of synchronism"? Give an Example.

A. My bills amount to sixty dollars and my pay check is for only fifty.

What is meant by "Non-Sync"?

A. An operating room without a wash bowl.

What do you think of the Talkies for your patrons?

A. Great. They used to take a nap. Now they get a Sound Sleep.

Getting Something Out of Nothing

By JOHN W. HAMMOND*

WHEN the front page of a San Francisco newspaper is read in New York State a few hours (elapsed time) after it is printed; when a popular lecturer makes a ray of light produce music and transmit his voice across the room; when Australia chats with America, and engineers talk of bringing waterpower from Pacific slopes to within reach of industrial markets in the northeast—even the sophisticated denizen of this ultra-modern world begins to inquire "Wherefore?" And the answer he gets has more than a touch of the mysterious, for they tell him, "It's the vacuum—it's all in the vacuum!"

In the vacuum! But can there be anything whatever in a vacuum—defined as mere empty space, devoid even of air? Tremendously and emphatically, yes! Truth, in the twentieth century, is more than ever stranger than fiction, for this is truth; and the man who first uttered the paradoxical statement, "The vacuum—there's something in it"—Dr. Willis R. Whitney, director of the research laboratory of the General Electric Company—conducts an institution which is engaged in nothing else than making truth stranger than fiction.

Utilizing Vacua

Little unobstructive glass tubes each enclosing one of these curious areas of "nothing-something" enabled a whole newspaper page to be reproduced within three hours clear across the continent and allowed Admiral Byrd in New Zealand to converse with his friends in this country, "face to face" nine thousand miles apart. Similar vacuum devices measure the heat and light of far distant stars; sort, grade and count quantities of small articles; safeguard premises from burglary and fire; turn on lights when darkness approaches; operate train signals, control electric motors, actuate compasses for ships and airplanes. Man has succeeded in utilizing the vacuum for transmitting entertainment programs great distances through space without connecting wires, for sending his messages to inaccessible or isolated spots, for aiding materially in alleviating his physical ailments. Every time he even switches on electric lights in his home he relies implicitly upon vacua, and millions of cubic feet of such light-giving "emptiness" are in nightly use throughout the world.

It has grown trite to allude to "scientific wizards." Yet the more trite it becomes, the more wizardry they perform. Getting something out of nothing—or practically nothing—is one of their concrete achievements today, for already they have obtained more wonders from the vacuum than a stage magician could extract from a silk hat.

The very nature of a vacuum gives it a tremendous aspect. Few persons outside the scientific world can readily conceive of a space entirely empty of matter, even of the gaseous substance termed the air. Hence, when the earliest scientific "magicians" began doing tricks with vacua they utterly astonished the laity. The classic experiment of Otto von Guericke with the two hemispheres was a long-remembered case in point.

Von Guericke's Experiments

Von Guericke, burgomaster of Magdeburg, was a pioneer in electrical science. His accomplishments included the invention of an air-pump with which he obtained a partial vacuum—not a high vacuum, such as is common today, but still one in which the air content was pretty thin. One day in 1654 he called by appointment on Emperor Ferdinand III., accompanied by two teams of eight horses each, with their drivers and various queer paraphernalia. He showed the emperor two copper bowls which, when placed together, formed a hollow sphere. Between them von Guericke inserted a ring of leather soaked in wax and oil, making an air-tight joint, but there was no mechanical connection whatever. With his air-pump he drew off a great deal of the air from the sphere through a hole which was closed by a tap.

The teams of horses were then brought up, one being hitched to each of the copper bowls, or hemispheres. At the signal to go the sixteen horses pulled and strained, but their utmost exertions could not drag the hemispheres apart. The emperor, amazed, found it impossible to believe that the bowls were locked together merely by the difference in air pressure between the atmospheric density outside and the partial vacuum within.

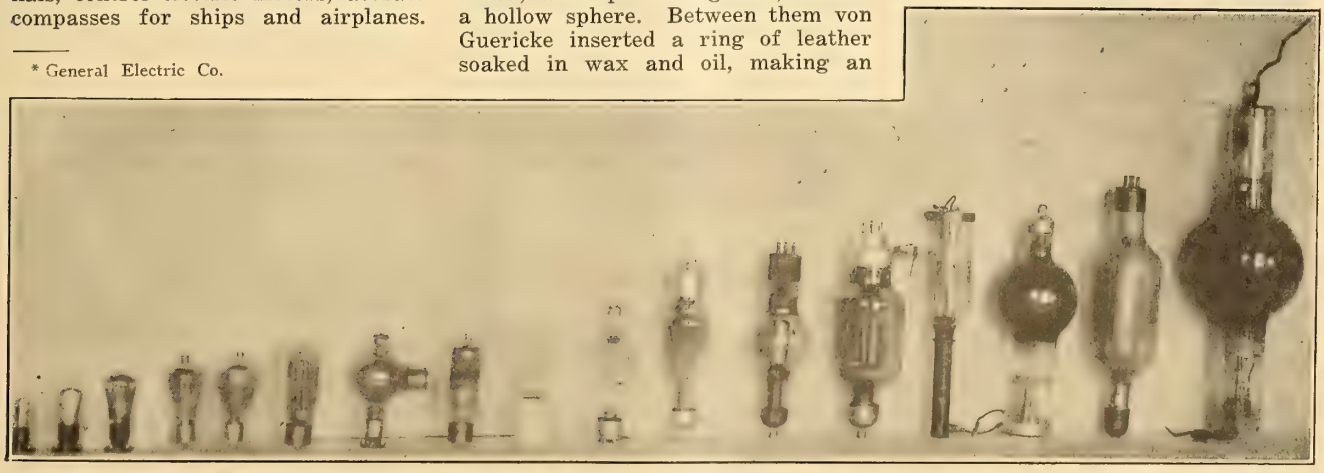
This was the vacuum doing tricks. The vacuum universally at work did not come until two centuries later, and Edison was the scientific "magician" of this later affair. By that time men knew much more about electricity; and there is a close working relation between electricity and the vacuum. Edison hit on a relatively minor aspect of it when he placed a hair-like carbon filament within a vacuum and then connected the filament to an electrical circuit.

The resistance of the filament to the passage of the electric current made it glow with incandescent light, while the vacuum prevented it from burning up—and lo! the incandescent electric lamp was born, essentially a vacuum device.

"Tons of Vacua"

Had Sir Walter Scott seen this he might have paraphrased his own incredulous comment on the experiments of William Murdock, the pioneer of gas lighting. When he heard of Murdock's work he exclaimed: "There is a mad man who proposes to light London with—what do you think?—smoke!" If he had known of Edison's lamp he would probably have scoffed: "There is a

* General Electric Co.



Various types of vacuum tubes developed by General Electric

mad man who expects to illuminate the world with—what do you suppose?—nothing! A vacuum!"

As it was, Edison's idea of an electric lamp was considerably ridiculed at the time. Among other criticisms, doubts were heard of the possibility of producing with facility such a high vacuum as was necessary. Sir William Crookes, the English scientist, who was then studying the subject, was asked if vacua as high as Edison required could be created in quantity. He replied, promptly and succinctly, "Why, such vacua can be produced by the ton!" And so they have been, ever since.

Edison, as fate would have it, did more than construct a practical and popular electric lamp depending on a vacuum. He was the first to observe a peculiar electric current originating with the hot filament inside the vacuum and known at the time as the Edison Effect. It was thirty years before scientists, working principally with Crookes' tubes, fully understood what this meant—that a hot filament in a vacuum gives off a stream of electrons (an electric current, but not usually a powerful one), capable of being manipulated in many remarkable ways and behaving variously in vacua of varying degrees.

Other Contributions

In the successive brilliant discoveries that occurred in this great field, Millikan, J. J. Thomson, Fleming, DeForest, Langmuir—all of them laboratory experimenters of the great line—participated. This work culminated at length in the modern vacuum tube with its boundless possibilities, already numerous and by no means even approaching finality. Radio broadcasting, one of the most spectacular and best understood of modern feats with vacua, was one of the earliest, following that of radio telegraphy.

Great numbers of these modern tubes are now in world-wide use, each with its vacuum, and each vacuum more nearly perfect than ever before produced by man. So completely are these tubes and bulbs "exhausted" (that is, evacuated of air) that out of every seven hundred million molecules originally in each tube only one remains! Yet in every cubic inch of space in each tube there are still to be found, after the pumps have done their best, more molecules of air than there are people in the world. Thus it is far from utterly empty space, although a living creature in such an enclosure would instantly suffocate, if he did not literally explode before he had time to smother.

This is quite sufficiently a condition of "empty" space, and innumerable such spaces are now in constant useful service in the every-day world. During the fall of 1929 General Electric manufactured its one hundred millionth vacuum tube. It is roughly estimated that about 250,000,000 tubes have been produced by all manufacturers since vacuum tubes first made their appearance, around 1915. If all these tubes are still in service they represent in the aggregate a million and a quarter barrels of vacua.

They comprise a diverse and extraordinary scientific family, these vacuum tubes. The first of them was the well-known pliotron of Langmuir. The most recent, the thyratron, just developed by Dr. A. W. Hull in the General Electric laboratory where truth is made stranger than fiction, is capable of greatly simplifying electric power transmission and solving some of America's economic problems of power supply. Thus out of the vacuum—out of practically empty space—the scientific wizards of today have already brought whole industries, wealth, prosperity, advancement, perhaps a new phase of civilization!

Obviously, then, the present electric age, so-called, is unfolding in really astounding fashion. More and more the scientist is thinking of electricity—the invisible inconceivable tiny electron—as the warp and woof of the physical universe. If this be so, the electrical age not only has come to stay but it may in time reveal its successive distinctive epochs, like the geological eras in the age of the earth. The world has already passed through the magnetic-electrical epoch; now it is entering upon the vacuum-electrical. Perhaps this will be followed by the atomic electrical, and that in turn by the cosmic-electrical, in which tremendous undiscovered forces of outer space will become servants of dominant man. In that epoch a literal tour of the solar system may have been practically achieved, and the world will have daily despatched its interplanetary Lindbergh—a good-will ambassador to the stars.

Fantastic? Ah, but "truth is stranger than fiction"—and stranger than ever as the years pass.

Rehearsals Necessary, Says Executive

REHEARSALS are a very important feature of good sound reproduction, according to Sidney Abel, general sales manager of RCA Photophone, Inc. Mr. Abel contends that theatre managers should become "sound-minded" and should give the projectionist every cooperation so that he may get the most out of a sound picture program. One of the most important steps in this cooperative enterprise on the part of manager and projectionist, stated Mr. Abel, is the maintenance of a regular rehearsal schedule on all sound subjects.

"It is becoming increasingly important for the exhibitor to provide his audiences not only with the type of pictures that entertain them but also with quality sound reproduction," said Mr. Abel. "Indifferent reproduction drives patronage away more quickly than perhaps any other factor.

"How then is the exhibitor to proceed in order to obtain ideal performances? Of course, he must first provide himself with good reproducing equipment. Acoustical treatment should be installed, if necessary.

Aid for Projectionist

"Projectionists must be given every assistance. It should be remembered that they are most important to the success of the show. Assistance and cooperation between management and projectionist is most essential.

"In my opinion, one most important factor only too often overlooked is that of rehearsal. The advisibility of rehearsing each show cannot be over emphasized. More now than ever before the projectionist is a very busy man. He must, in addition to running the show, check his entire equipment frequently. Arc lamps, projectors, sound heads, turntables, amplifier equipment, and auxiliary devices such as batteries, charging equipment, etc., must receive attention. Film must be rewound and inspected after each run.

"The projectionist certainly is not in a position to accurately judge the volume of sound in the auditorium. Rehearsals enable the theatre manager to determine the proper volume levels for each subject and even for each scene, as is sometimes necessary. Scientific tests have shown that definite fatigue is suffered by those listening to sound that is either too soft or too loud. To obtain the desired effect it is necessary to maintain volume at a normal level.

"In this case 'normal' denotes that particular level which sounds most natural for each subject. A close-up should be somewhat louder than a long-shot, etc. Too frequently in theatres the shouts of a mob or the roar of a cannon are barely audible, while the voice of a little girl booms forth with terrific intensity. Conditions like these cause much unfavorable comment, and the impression given is that the management is slipshod and the projectionist delinquent in his duties.

"Rehearsals enable the projectionist to properly set their cues. In many cases changeovers must be made precisely to avoid cutting part of the dialogue. Inspection by prior screening is a far better way to do business than to trust to luck that the print and sound track will be in good condition.

"Rehearsals may be a bit more of an expense, but to my mind they constitute the best insurance of a satisfied audience."

Some Common Causes of Trouble

RCA Photophone Equipment

THE following will give the reader a brief description of the more common troubles which might occur in RCA Photophone "SPU" equipments with their causes and remedies.

No Sound with Discs

No sound when using discs may be due to one or more of the following:

(a) Switches and rheostats set incorrectly on the amplifier panel.
(b) Film-disc switch set in the wrong position.
(c) Fading potentiometer in the "Off" position or set for the wrong projector.
(d) Output fader in "Off" position or wrong one being used. (On "B," "C-1" and "D-1" installations.)
(e) Power amplifier AC supply circuit open. The primary voltmeter will then be at zero. Replace the line fuses if they have blown.
(f) Voltage amplifier defective or two tubes in the same stage burnt out. Change to the other voltage amplifier when one is available.
(g) Pick-up defective. Rub the needle with the finger. Swing the fader to other projector, and if sound comes from that pickup and not from the other, it is usually a sure sign that one of the pick-ups themselves are defective. In that case change pick-ups. Try a new one. Make sure that the contacts on the pick-up are clean and tight.
(h) Loudspeakers not plugged in on the stage.
(o) Short circuit on the voltage amplifier "A" Battery line. Both pilot lamps and voltage amplifier tubes will be "out." Change to the other storage battery. Test the fuses of the four-pole double-throw switch in the battery line. If blown, test for the location of the short circuit as follows:

Turn the battery switch off and disconnect the plugs on the input control panel. Insert the new fuses in the four-pole double throw switch. Turn the battery switch "On." If the fuses blow, make the same test with the other voltage amplifier in the circuit. Re-connect the plugs on the input control panel one at a time. The trouble is in the part of the circuit which blows the fuses when connected. Operate with this part of the circuit disconnected, if possible. (Of course, in installations where the plugs are not used, this cannot be done.)

Low Volume with Disc

Low volume with disc may be due to:

(a) Storage battery discharged. Switch to the other storage battery.
(b) Voltage amplifier defective. Change to second voltage amplifier if possible.
(c) Pick-up defective—low volume on one projector only. Use a new pick-up if the other projector gives decidedly better results. Clean plug contacts on pick-up.
(d) Where more than one power amplifier is used, it is possible that one of the power amplifiers may be defective. If the individual fuses on the power amplifiers are blown, replace them at once. If the plates of the rectifier tube get very hot (cherry red) turn "Off" the switch at this power amplifier. Adjust the primary voltage reading to 100 volts.
(e) Burned out tubes.

If at any time during the show the volume suddenly decreases, make sure that all tubes are in operation. If one of the tubes should burn out, the only notice the projectionist may have will be a decrease in volume. It is possible for as many as two or three tubes to be burned out at one time; as long as two tubes are not "out" in the same push-pull stage, the equipment will continue to operate.

Poor Disc Quality

(a) Poor discs. (b) Dirty discs. (c) A burned out UX-281 in the power amplifier will cause a loud hum to be heard above the sound. (d) Defective pick-up on one projector. Use a new pick-up if the sound from the other projector is all right.

Needle Jumps Groove

This trouble may be due to: (a) Warped records. (b) Tone-arm binding. (c) Bottom of pick-up striking the face of the record due to short needles. Do not insert the needle all the way. (d) If the turntable is not absolutely level, the needle may jump when starting.

"Wow Wows" with Discs

(a) In very cold rooms where the vaseline might become very hard, it will be advisable to run the projectors for fifteen minutes before the show to warm the lubricant to normal temperature. This can be compared with the difficulties involved in starting an automobile on a cold morning when the transmission oil becomes stiff and makes it difficult for the starter to turn the engine. If "wow wows" continue after proper use of vaseline, and if the projectors are warm, test the viscous damping devices.

(b) If a turntable coupling is out of line, "wow wows" are liable to result. The remedy is to line up the turntables. Call the service man.

Excessive Disc Scratch

Excessive scratch may be caused by too much weight on the pick-up, or a very old disc. The weight at the needle should be six ounces. This should be checked carefully. It is also important that, if a disc has been used previously, the same type of needle is used the second time. For instance, if half-tone needles were used on a record of ten complete playings, and another theatre received the same record and used a full-tone needle, very disagreeable sounds are liable to result. Most film companies recommend a certain type of needle to be used with their records.

Unequal Pick-Up Volume

If greater volume results from one pick-up than the other, it is possible to equalize this at the film disc box located either on the front wall of the booth, or on the top of the soundhead. In the Type "F" installations, this control is located in the terminal box on the side of the turntable. Both pick-ups should be balanced for the same volume. A very good method is to take two records of the same selection, starting both projectors at the same time and fading from one to the other. This will give the projectionist a very good idea of tone and volume from each pick-up.

No Sound with Film

All troubles that apply to no sound-on-disc may be applied in this case, except defective pick-ups. In addition to those items check the following:

(a) Exciter lamp burned out. Turn another lamp into operating position.
(b) Sound gate light aperture completely clogged. Clean the aperture.
(c) Defective photo cell. Try a new one.
(d) Check photo-cell voltage at voltage control panel for proper polarizing voltage.

Low Volume with Film

(a) Exciter lamp current incorrect. (b) Exciter lamp out of focus. Turn another lamp into position. Make the card test at the first opportunity. (c) Sound gate aperture partly clogged. Clean the aperture. (d) One or more tubes in the voltage amplifier are not lighted. Change voltage amplifier or replace the defective tubes.

(e) Photo cell defective—low volume on one projector. Use a new photo cell if the other projector gives decidedly better results. If possible try correcting the volume by either de-

creasing the exciter lamp current to the projector from which the louder sound is obtained, or by increasing the exciter lamp current to the projector from which the weaker sound is obtained. If it is impossible to balance this way, put in a new photo cell.

Poor Sound-Film Quality

Poor quality with sound on film may be due to any of the following causes: (a) Poor sound film. (b) Dirty sound gate. (c) Dirty film. (d) Dirty constant speed sprocket. A dirty constant speed sprocket will sometimes cause a "flutter" in the sound.

(e) Poor quality may be caused by defective photo-cells. A photo-cell may become poor through physical misuse. It is very important that the operator does not expose a photo-cell to extremely strong light at any time, whether a polarizing voltage is being applied or not. They must be handled gently and not jarred. When no film is in the projector, the circle of light from the exciter lamp can be seen on the photo-cell, and this circle should be located at the exact center of the plate in case of the UX-868 cell, or in the center of the window in the case of the UX-867. Dirty contacts on the photo-cell may also cause trouble. These can be cleaned very readily with a little fine sandpaper or "crocus" cloth.

"Wow Wows" with Film

If "wow wows" are noticeable when running sound on film, it is possible that the sprockets are dirty, or the constant speed sprocket is excessively worn. This should be checked very carefully. Also check the viscous damping device in the sound head.

Noise or "Motor-Boating"

Noise or "motor-boating" may be due to any of the following causes:
(a) Dirt and acid on top of the storage battery. Switch to the other battery and clean the dirty one.
(b) Gasing storage battery. Do not use a storage battery sooner than one hour after charging, unless in an emergency.
(c) Loose storage battery terminal connections. Clean and tighten.
(d) Loose connections to dry batteries.
(e) Poor ground connection on the projectors. Clean and tighten.
(f) Noisy photo cell polarizing battery. Check for low voltage.
(g) Noisy or old "B" batteries on the voltage amplifier.
(h) Optical system out of adjustment in such a way that the light ray passes through the sprocket holes of the film, or through the frame lines of the picture.
(i) Defective "C" Batteries, check for low voltage.
(j) Guide rollers out of adjustment. The guide rollers in the sound gate shoe should rotate freely. There should not be any side play in the outside roller, but it should not bind on the gate shoe. If this guide roller is loose or out of position, the film will weave in and out through the gate, thereby causing "motor-boating" or "film noise" and the reproduction will be very poor when using sound film.

Whistling Sounds

When an unusual whistle or foreign noise occurs, it is usually a sign that one of the UX-250s have become defective, not burnt out, but its filament omission may have dropped. When the UX-250's are greatly unbalanced in plate current, it is usually indicated by a whistle. If this occurs, it is necessary to determine which power amplifier it is that is whistling. Insert the monitor plug in each monitor jack until the monitor speaker itself whistles. This will indicate that it is the amplifier into which the speaker is plugged that is whistling. The two UX-250 tubes should be removed from the amplifier and replaced with a set of matched tubes from the theatre's spare equipment. Of course, in the case of a "D," "D-1," "F" or "G" there is only one power amplifier, rendering it unnecessary to go through this procedure to determine which amplifier is whistling.

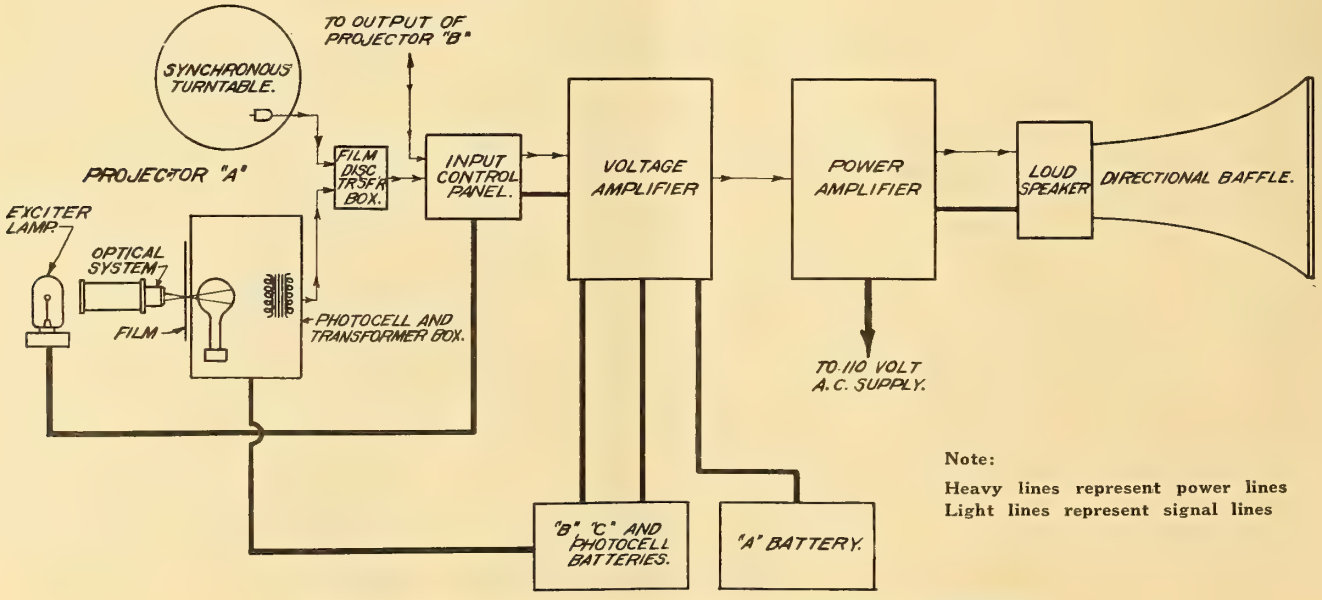
If replacing the UX-250s does not stop the whistle, put in a new set of UX-281 rectifier tubes. In most caces, replacing the tubes in the power amplifier will stop this whistling, but if the whistle continues after all the above mentioned things have been done, it is possible that the whistle may come from the voltage amplifier. Tap gently each tube in the voltage amplifier, one at a time, to ascertain if any are excessively microphonic. It any of the tubes are abnormal in this respect, replace both tubes in the stages containing a defective tube with two new tubes. A whistle may also be caused by unusually low "B" batteries. At the same time check the "C" batteries. The "C" batteries should read 9 volts at all times.

Noisy Fading

If clicks are heard when moving the fading potentiometer, it may be due simply to dirt on the contact points. The contacts may be reached for cleaning by removing the knob, and taking the four screws out of the escutcheon plate. Immediately behind this plate are the contacts. They may be cleaned with a very fine grade of "crocus" cloth or sandpaper, and then wiped off with a soft cloth. A soft cloth with "Carbona" is very good for cleaning these contacts or those of any kind of relay.

Cross-Talk (Type F Installations)

Should cross-talk develop, that is, if sound is heard from both projectors at the same time, it will usually be found that dirt has collected on the contacts of the fading relay.



Elementary diagram showing operation of RCA Photophone equipment

A Projector Built for Sound

By O. F. SPAHR*

IN the natural enthusiasm with which the development of sound production was carried forward in order to perfect reproducing systems which would successfully coordinate the reproduced sound in synchronism with the action of the picture, the projector was more or less forgotten or rather taken for granted. There were, however, certain considerations which were overlooked, leaving much from a mechanical standpoint that might be desired.

Engineers pioneering in the early research work on sound reproduction were scientists working on lines of endeavor entirely different from motion picture projector mechanics. Being first interested in systems for reproducing sound, it is quite appreciable that they would start with the projector which would be most conveniently available and in present theatre use. This they did and the result was that all of the various types of sound systems were designed as attachments for the then-existing types of projectors—a condition not entirely satisfactory to either the sound equipment or the projector equipment. Some equipments did not operate with full satisfaction with a particular projector, and likewise some projectors did not fully meet the requirements of the sound equipment.

It is undeniable that one cannot enjoy a thorough understanding of a given subject unless one is familiar with its development. To this end it would be interesting to pause before going into detail on the new sound projector and look back upon the development of the projector manufacturing art as exemplified in the progress made by this company in its twenty-five years of projector manufacturing.

Many of the "old timers" will recall the small mechanism shown to the right in Figure 1. This was the first commercial model of what later became the "Motiograph." To the left in the same illustration is shown the development model. Improvement is evident even in this early beginning. The development model had no shutter and the crank was located on what we would now consider the wrong side. However, the commercial model had the crank placed on what is now generally accepted as the "operating" side.

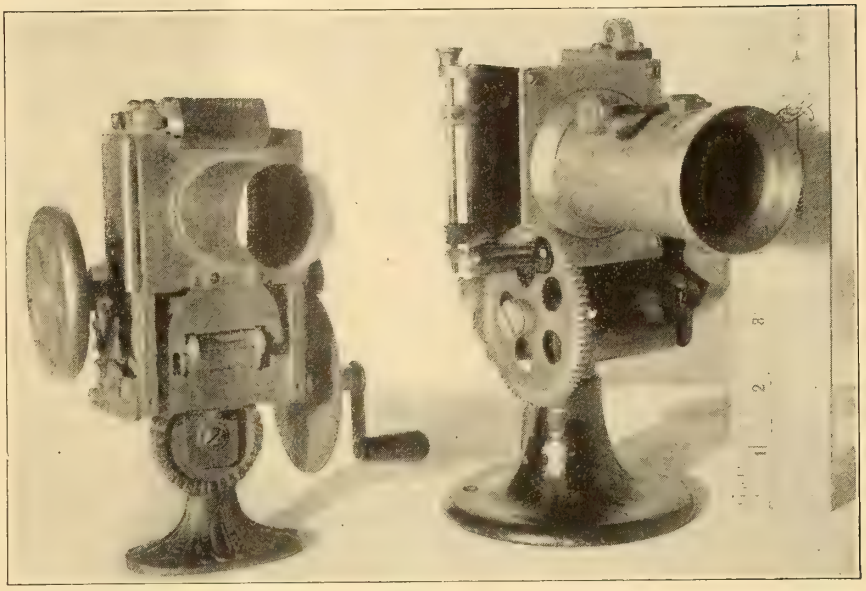
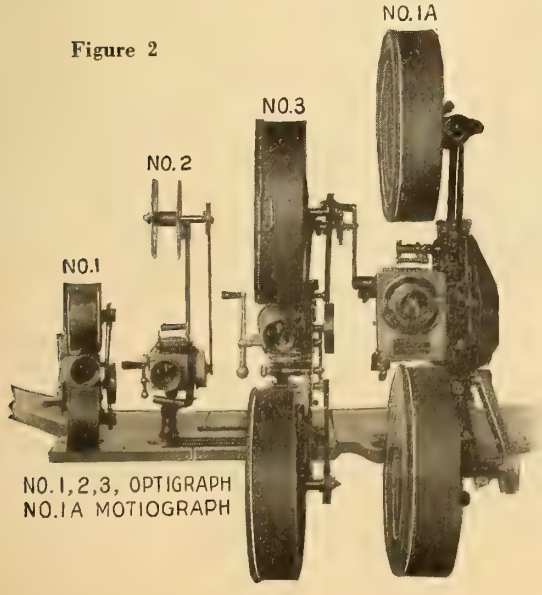


Figure 1

Figure No. 2 is interesting in that it shows the development of the "Optigraph" as it was then called, from Model No. 1 to Model No. 3. Curiously, No. 1 was the first attempt to provide magazines to enclose the film and was the first to provide a take-up device. In those days film ordinarily came in only 50-ft lengths.

To the left, in Figure 2, is shown the first model to be called the "Motiograph." This was considered a remarkable achievement and so it really was in its time. It was the first projector to have an entirely enclosed mechanism, perfected take-up and fire-proof film magazines. It had much to do with the elimination of flicker which at that time was a common fault in projection. The shutter in this model was of double cone construction, operating between the film and lens and really produced flickerless projection. This model appeared about 1909 and, strange as it may seem, there are still some of them in daily operation, since we occasionally receive one at the factory for repairs. Incidentally, in this model came the birth of the removable, or unit type of intermittent movement. It was of double-bearing construction and was, we believe, the first projector constructed which offered the advantages of an intermittent movement which could be removed as a unit or replaced with a spare or like movement.

Figure 2



Up to this time no serious consideration was given to the base or understructure of the projector. The mechanism was the thing. In many instances it was used as an addition to a stereopticon lantern for the showing of motion pictures to "supplement" a stereopticon lecture!

However, the store shows and nickelodeons of the early days of the industry were now beginning to become popular and more serious thought was given to the base of the projector. In Figure 3 we see one of the first types of complete projectors. Almost all projectors of this period had a "wood board" as a base on which was mounted the projector mechanism and the lamphouse. Likewise, most all projectors had telescoping legs attached to the underside of the wood base. Naturally, this type of construction, while offering the advantages of adjustment and portability, was not in any sense of rigid, or stable construction. Most projectors were cranked by hand and considerable side sway and unsteadiness of the projected picture was notable in projection due to the unstable type of projector base.

Although it is not generally known, Motiograph was the first to recognize this condition, and, as may be seen in Figure 3, was the first to manufacture a complete projector having a motor drive equipment. It is interesting to note that at this time mazda lamps for projection were first being recognized as practical. In Figure 3

* Enterprise Optical Mfg. Co.

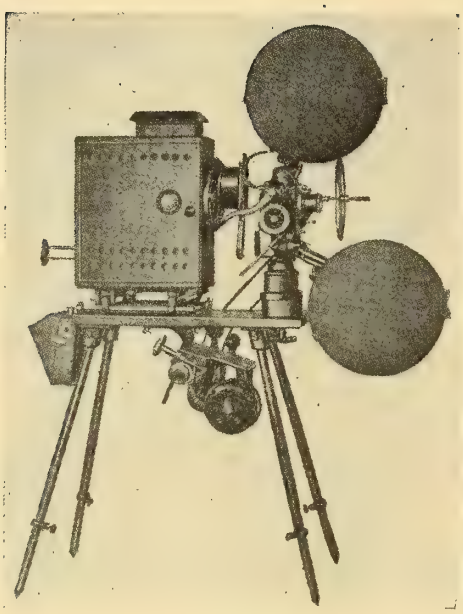


Figure 3

may be seen what was probably the first commercially-developed projector with mazda lamp equipment.

The popularity of the motor-driven equipment being assured, engineers next concentrated on designing Motiograph equipment for better projection. Recognizing the need for greater stability and a more permanent type of equipment, the 1002-D Model as shown in Figure 4 appeared about the year 1916. In this model many outstanding improvements were incorporated. The unit design of the intermittent movement was retained but greatly improved by the addition of a balance wheel on the cam shaft. This materially improved the steadiness of operation and, with improvement in design of star, cam and sprocket, real projection was secured. The inside shutter was discarded in favor of the outside rotating disc type and since better theatres were being built and programs increased in length, a new type of regular arc lamp was introduced on this model which had many innovations in positive control of the carbon by adjustments which permitted a steady and uniform light to be obtained. The motor drive on this model permitted variable speed through a wide range and was a considerable improvement over that of the first type.

During this period, progress was becoming very rapid. Theatres were becoming more and more elaborate and projection requirements more exacting. Need was felt for a more advanced type of projector and again the Motiograph engineers developed equipment to meet the requirements with the announcement in 1918 of the Model 1002-E Motiograph DeLuxe as shown in Figure 5.

Here we see further development of the base of the projector in that the E Model had a heavy cast base designed for permanent installation. This design also permitted better facilities for tilting the projector and to provide a more stable support for the arc lamp which in itself was still further improved and provided in this equipment with an automatic arc control The mechanism on this model was still further developed, having many innovations not available on the earlier models. The E Model had an in-built driving attachment, carrying a pulley for the belt to the motor. The drive attachment being so designed to permit the direct application of power to the mechanism through gear reduction which permitted the least strain on the vital parts of the mechanism. The film tension was improved to allow greater speeds of projection and many mechanical improvements in the mechanism were made. The motor drive on the E Model was an improvement over previous models in that changes in speed were obtained through the means of a mechanical speed control, whereas previous models operated on the principle of varying the speed of the motor.

In the short space of three years, projection conditions had so rapidly changed that another new equipment was designed and in which the engineers endeavored to incorporate that which they believed were principles of projection which would meet the most advanced requirements of projection. Field representatives having carefully analyzed the trend of the industry and being in constant touch with projectionists, a most careful analysis of the forthcoming requirements of projection was made and given to the engineers to work on. The result was the Model 1002-F Motiograph DeLuxe, pictured in Figure 6.

In this model were incorporated many decided manufacturing refinements and principles which have proven their merit through the years and which remain unchanged even in the latest models of today. Included in these are the use of removable and replaceable bronze bearings for all shafts in the mechanism, the shifting frame method of framing the picture which allows the film loops to remain unchanged, and the perfected tension system for the film which permitted the highest of projection speeds with rock-steady projection and without damage or strain on the film.

The mechanism, entirely enclosed

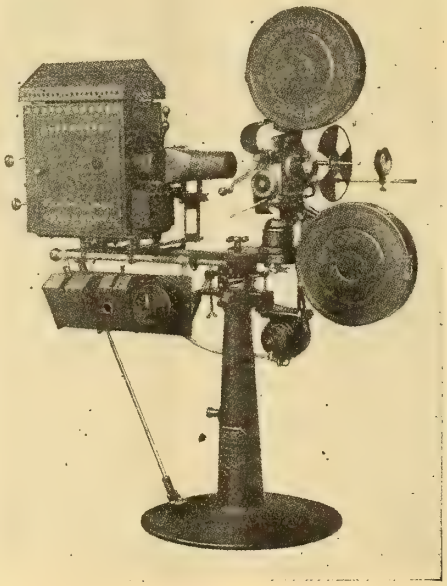


Figure 4

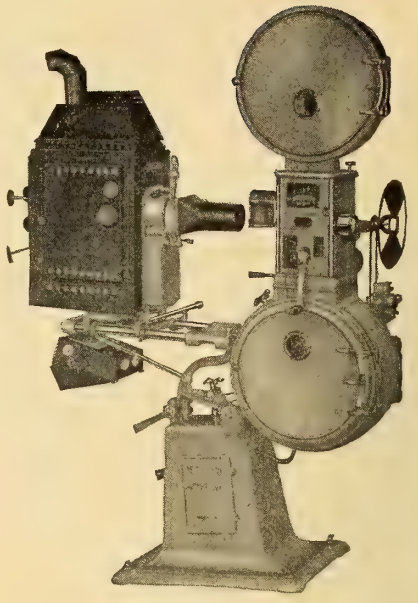


Figure 5

and much larger than any heretofore, had many new features including a micrometer focussing arrangement, mechanism pilot lamp, a new type of intermittent movement with hardened and ground star, cam and sprocket, glass windows in the doors and all doors removable without tools for ready inspection and cleaning.

The motor drive was still further improved, being built in as a part of the projector and employing the now well-known friction disc speed control. This was the first projector designed with a direct connected beltless motor drive.

The Model F first appeared with a single-bearing type of movement which was in popular demand during the year 1921 when it first appeared. This model has merited the advanced ideas incorporated in its design and is still manufactured and sold today. It has retained its popularity since its first appearance, though many new improvements have been made. About 1925 it was equipped with the now famous Motiograph double-bearing, ball-bearing intermittent movement, and later, a new arrangement of silent, heavy duty bakelite gears.

The design of the Model F was such that several types of lamphouses could be adapted to it. These included the regular arc of improved design, the Motiograph incandescent lamp equipment, the high intensity and later, the Motiograph reflecting arc lamp.

About this time, when projection conditions demanded intensely strong illuminants with the resulting greater heat on the film, the need was felt for some means of reducing the effect of this heat on the film and the consequent troubles of in-and-out-of-focus effect on the film due to buckling and warping from the intense heat of the light beam. This lead to the development of the now well-known model 1002-H projector with the horizontal cylindrical shutter which was the first projector to employ this type "rear shutter" (Fig. 7).

The success of the Model "H" and the horizontal shutter is so well-known, little need be said of it here.

Included with it in the Model "H" projector, were many other improvements. A new one-piece gear type of construction, greater strength for certain parts of the mechanism needed because of the added requirements of sound projection, a new type ball-bearing tilting device, and many other refinements were included.

From the foregoing one may see the gradual development of the projector and especially in the Model H where certain requirements for sound reproduction were considered.

For the past two years our engineers have been studying the relationship between the projector and sound, in an endeavor to develop that which should have been the primary consideration—a motion picture projector designed to function perfectly in conjunction with the sound equipment. Following these researches, we proceeded to build that projector so that the necessary mechanical and electrical requirements for sound reproduction would be built-in and would operate as part of the projector.

An analysis of all the various sound motion picture equipments disclosed that every one was essentially an attachment to the projector, the methods of adaptation ranging from a simple form of turntable connected to the projector by more or less makeshift arrangements, to an elaborate complete understructure on which was used only the mechanism, lamp and upper magazine. With no sound equipment available, was it possible to procure a *sound projector*—that is, a motion picture projector equipped for good sound reproduction, *which was designed and built for that specific purpose?*

A study of the typical sound systems disclosed that the equipment consists essentially of three divisions, which might be termed the sound projector comprising the motion picture projector with the necessary attachments for pick-up from film, pick-up from disc, motor drive, etc. The second division would include the amplifiers and also the main and head amplifiers, batteries, chargers, etc. The third division would include the speakers and necessary backstage equipment. The second and third divisions in most of the better systems have been quite satisfactory worked out; however, in the opinion of our engineers, none of them offered a real sound projector such as they had in mind.

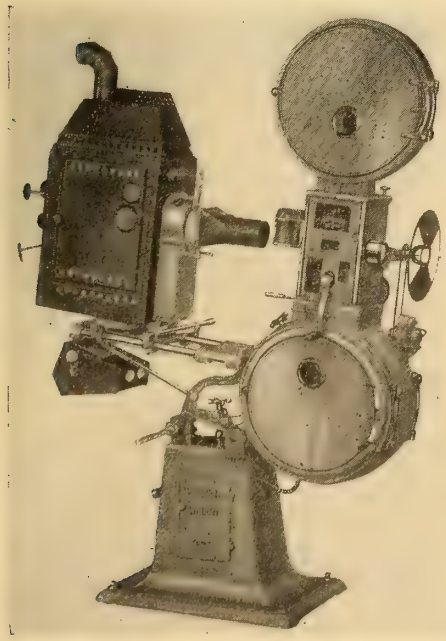


Figure 6

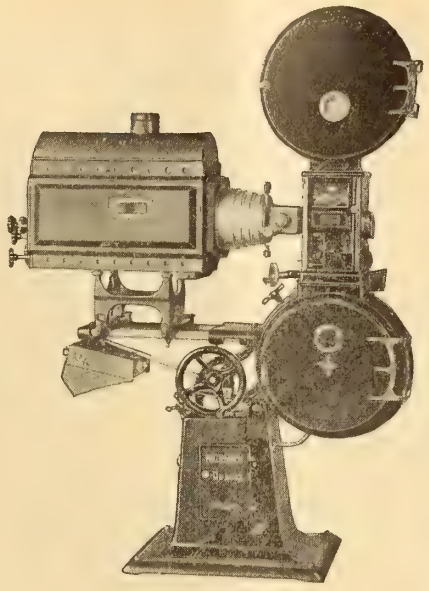


Figure 7

Therefore, we see in the Motiograph De Luxe Sound Projector the first and only motion picture projector designed specifically for the dual service of sound reproduction and motion picture projection. Here we have a sound projector embodying the very latest developments. The projector consists of first, a very substantial base providing the necessary solidity and understructure so necessary to support and properly coordinate the operation of the added equipment for sound reproduction.

Built in the base is the motor support and adjusting cradle. The motor is so mounted that it is readily accessible for adjustment, lubrication, etc. The motor is of special design, ⅓ h. p., having more than ample reserve power, as well as characteristics to compensate for the commercial variations in line voltage, so that it always maintains its constant speed. The base is provided with leveling screws for screen alignment and a well-designed tilting device with braced and locking features to insure permanent position and screen registration of the projected image.

Mounted at the rear of the base is the turntable mechanism. This is of unit design, i. e., it is a complete separable unit, yet becomes an inherent part of the assembly when assembled. The turntable embodies the latest developments, which include a cushioned drive direct from the motor, a flywheel balanced reduction unit, and another cushioned drive between the reduction unit and turntable. A compensator or mechanical filter is provided to absorb all mechanical vibrations and to insure exact true speed of the turntable proper.

The electrical pick-up for disc reproduction is of the latest "tuned adjustment" type to insure perfect disc reproduction.

The turntable unit is so located on the projector that no additional floor space is required for the projector over that required for the regular silent type projector. It is convenient for operation, yet out of the way. An adjustable lamp is provided to insure ample illumination of the record as well as a needle container of unique design. The discarded needles are deposited in a separate compartment from which they may be readily removed and discarded.

Mounted on the sturdy lamphouse support rods is the control cabinet in which is mounted the arc lamp switch and motor control switch. Any type of lamp and lamphouse may be mounted as desired.

Above the lower magazine, which is of ample proportions, is mounted the sound-on-film reproducing unit. This is also of unit construction, being a complete assembly in itself, but becomes an integral part of the projector when assembled. Many innovations and late developments are incorporated in this unit. Absolute steadiness of film travel so essential for perfect sound reproduction is assured by a 26-lb. fly-wheel within which is incorporated a mechanical filter or compensator of improved construction. It is mechanically perfect, and while extremely sensitive, as it must be to function perfectly, it has no delicate parts and is sturdily built to withstand constant operation. To sustain the weight of this device a long bearing, being a combination of ball-bearing and bronze bearing, provides ample insurance against wear, and full assurance of free operation. On the shaft of this compensator is mounted the pull-down sprocket, and driven from it is the hold-back sprocket.

The sound-film unit includes a two-socket exciter lamp mounting, each lamp being pre-focussed and instantly shiftable into exact position in the event of exciter lamp failure.

The optical slit unit is of our own special design. It produces the light slit *optically* instead of mechanically,

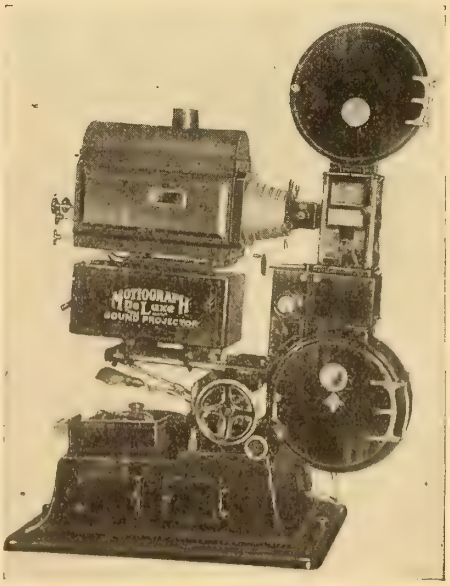


Figure 8

and its efficiency over the mechanically produced slit is such as to provide approximately a 300% increase in illumination. This is a two-fold advantage in that the greater light flux impressed on the photo-electric cell establishes a greater output from the cell assuring amplification of true value and ample volume without "pushing" the amplifiers to the distortion point. At the same time it allows operation of the exciter lamp at a lower amperage, thus assuring longer life and efficiency for the lamp.

The film travels over a curved aperture block in the sound film unit, there being no tension pads or springs to pick up emulsion, dirt or cause other troubles. Ball bearings guide rollers assure perfect film registration with the sound slit aperture.

In the forward compartment is housed the photo-electric cell; and included here is another exclusive Motiograph development in a device which eliminates what are erroneously called "surface noises."

Mounted above the sound film unit is the projector mechanism. This is the well-known Motiograph Model "H" mechanism which was especially designed for sound film projection. This mechanism employs the horizontal-cylindrical shutter mounted between the film and lamphouse and which eliminates 62½% of the heat from the film. It also provides air currents to cool the aperture and gate and draw free dust and dirt from the film, heat and dust on the film being enemies to good sound reproduction. The mechanism includes many other improvements directly contributing to perfect sound reproduction.

The mechanism and sound film unit are adjustable to each other and are driven by a unique arrangement which transmits power direct from the motor, driving the mechanism, sound film unit and turntable in exact unison.

All electrical wiring for the sound devices on the projector is of approved design, and is concealed within the projector units, assuring a neat installation. Outlets to the amplifiers terminate in a junction box at the front of the projector base; motor and lamp lines in a fused terminal block within the base covered by a door providing ready access to terminal block for inspection or renewal of fuses.

Print Control of Volume

By DOUGLAS SHEARER*

FROM the outset of sound pictures, one of the most difficult conditions to overcome in recording and reproduction has been the adjustment of the volume of one scene to another. In addition, there was the problem of presenting certain parts of a picture more loudly or softer than other parts, according to the dramatic and realistic requirements.

It was impossible to accomplish these results in mixing the original recordings. First, because it is impossible to do film recording on two successive days at exactly the same volume. Secondly, the normal volume range, which is capable of being put on film is not large enough to permit intercutting a scene requiring a large volume of sound with a scene requiring a small volume of sound, except by using the theatre volume-control fader to the recording.

Eliminating the Cue Sheet

The original method of enlisting the aid of the theatre fader was through a cue sheet. This was distributed to theatre projectionists who would use it as a guide for making desired changes in volume as they ran the pictures. This system obviously allowed a large variable of the human element to enter into the showing of a picture. Frequently, cue sheets were entirely ignored; in other cases it was difficult for the projectionist to follow a cue sheet and also watch the projection machines. Also it was found difficult to indicate on a cue sheet the exact part of a picture where a change was to be made.

Still more often the changes might need to follow each other in such rapid succession that it was almost physically impossible to follow them. Altogether, the cue sheet has not proved particularly satisfactory as a means of adding volume range to the recorded product.

One method by which volume adjustment of the various scenes can be obtained is to re-record the original sound to a new sound negative, and in the re-recording to adjust the volumes to their respective correct levels. This method has the disadvantage of requiring some scenes to be recorded at a low enough point to allow full expression of louder scenes, which will produce throughout the whole length of the reel an abnormal surface noise.

Purely a Printing Operation

Metro-Goldwyn-Mayer Sound Department originally developed an automatic fader control which can be operated up and down at the desired points throughout the picture by means of a device operated by notches along the side of the film. These notches are placed on one side to move the fader up, and on the other side of the film to move the fader down, the fader being moved one point up or down for each notch. Although this method would operate satisfactorily, it involved the manufacture of equipment, its sale and installation in theatres. On this account it was not put into use.

In an attempt to find some means of regulating the volume from the film, whereby no additional apparatus would be necessary and whereby the desired control could be obtained as an integral part of the print, and whereby the human element would be eliminated entirely, we arrived at the present M.-G.-M. squeeze mat control method, which very satisfactorily accomplishes the desired results. The method is purely a printing operation.

The overall effect of this new M.-G.-M. system is to incorporate in the original film a variation in volume range equal to five steps on the fader. In general, this is ample to satisfy completely the requirements of the average picture.

One distinct advantage of this method is due to the fact that as the sound track is made narrower by the black mat, the surface noise reduces proportionately. The effect in the theatre is identically the same as though the fader were moved up or down. In fact it is impossible to distinguish by ear whether the fader has been moved or whether the track has changed in width.

The use of this M.-G.-M. method is foolproof, and in general will allow a whole reel of film to be run without any change in the fader setting, providing the reel has been started at the right volume by suitable prior adjustment of the fader. Release prints of the Metro-Goldwyn-Mayer product are now being turned out incorporating this valuable advance in the technique of presenting sound pictures.

A distinct advantage of this M.-G.-M. method is in the ability to make volume changes gradually, wherein it is superior to the fader control because the volume changes in the latter case are in definite steps, audible and objectionable to the listener.

* Recording engineer, M-G-M Studios.

Care of the Eyes

The extra work which is thrown upon the nervous system through seeing, reading, writing and sewing with defective eyes is recognized by all physicians as an important cause of disease. The tax made upon the nervous system by the defective eye lessens the supply of energy available for other bodily use, and the general health suffers. The health is improved when proper glasses are prescribed.

The following general precautions are worth observing:

1. Rest the eyes when they hurt, and as far as possible do close work—such as writing, reading, sewing, wood carving, etc.—by daylight.
2. Never read in a very bright or a very dim light.
3. If the light is near, have it shaded.
4. Do not rub the eyes with the fingers.
5. If the eyes are weak, bathe them in lukewarm water in which a pinch of borax has been dissolved.

Screen Companies Merge

Negotiations have been completed for the merger of Beaded Screen Corp., makers of the Vocalite screen, and Raven Screen Corp., makers of the Raven Transitone Screen.

Organized Publicity Service Created For Projectionists by Advisory Council

THE accompanying articles from the *Ottawa Evening Journal* of Ottawa, Canada, the *Rochester Evening Journal*, and the *Post Express* of the latter city, are excellent illustrations of the splendid work which is being done by the Projection Advisory Council. These articles are appearing in newspapers throughout the United States and Canada, with the aid of resident Council members, and clearly show how much can be accomplished by organized and systematized publicity work. Such notices do not appear spontaneously or because newspapers have awakened to a realization of the importance of projection. Newspapers need to have their attention attracted to such material, and for the first time in the history of the industry, an effort is being made to see that projectionists get none the "worst" of it in the public press.

Seeks Nationwide Support

In the vigorous prosecution of such a publicity campaign, the Council is merely taking a leaf out of the book of many successful business companies, religious institutions, governments, charitable organizations, political groups, etc. The importance of such publicity in creating goodwill for projectionists is incalculable, but it is certain that the process is storing up much favorable opinion that might be put to work at any moment.

The projection Advisory Council has already taken up projectionist publicity as one of its major activities, and it is seeking the assistance of resident members throughout this country and Canada. Just at present the Council is appealing to projectionists to assist in increasing the membership of the Council so that a nationwide representation may be had and thus facilitate the work of the Council in all sections. The Council has been extraordinarily successful thus far in conducting a campaign of considerable extent with the aid of a very minimum of expense account and outside membership help. An increased membership will naturally provide some additional revenue for the expansion of this work and will serve to develop a more closely knit organization.

Inquiries Invited

Those wishing to cooperate in the work of the Council are invited to get in touch with the nearest regional officer or address directly to the headquarters of the city to: Projection Advisory Council, G. P. O. Box 98, New York City. The articles previously referred to are appended hereto:

Rochester Evening Journal:

A CRITIC'S NOTEBOOK

By David Kessler

When you hear poor sound reproduction in a motion picture house, whom do you blame?

Personally, I've placed most of the blame upon the producers. Next in line for its share of the blame comes poor acoustics in many of the theatres built without thought of sound projection. Last of all in the matter of blame, to my mind, is the projectionist.

But members of the local union of projection men, according to a letter from H. B. Spencer, secretary, of No. 92 Spencer Road, believe that they are saddled frequently with the onus of bad sound effects. As a complete statement of their side of the question, Mr. Spencer submitted an article written by a New York expert on the subject, with the request that it be reprinted. Here goes:

It seems that there has been a tendency among the movie reviewers and the more restless of the movie patrons to blame those mysterious persons in the projection room when anything goes wrong with the sound in talkies.

Apparently the impression prevails that the experts who manipulate the sound apparatus in the theatre are wholly responsible for the results, good or bad. And now, after suffering in silence, the projectionists have emerged from their sound-proof boxes to protest, through the spokesmanship of their leader, Mr. William F. Canavan, against the contumely which has been unwarrantably heaped upon them.

Factors Affecting Reproduction

At a recent luncheon of the Projection Advisory Council, Mr. Canavan happily undertook to dispel some popular misconceptions in regard to sound. In commenting on his remarks, several trade papers point out editorially that there are numerous causes which may result in poor sound reproduction of which the projection is only one. Such factors as poor studio recording, defective prints or disks, bad acoustics and inferior reproducing equipment may be to blame. To quote from one of the editorials:

"Experience has demonstrated conclusively that many of our large first-run houses are delivering an inferior quality of sound, not because of any neglect, carelessness or ignorance on the part of their technical staffs but because they are very badly suited to the showing of sound pictures.

" . . . In by far the majority of cases projectionists are getting out of their sound equipments about all that they are capable of delivering. They are doing a conscientious job, but they cannot be expected to overcome the handicaps of bad prints and discs, excessive amplification, and sub-standard equipment which is installed in many theatres. Also, there is the factor of acoustics which is too often an almost insuperable obstacle.

"The projectionists of the country have done a remarkably good job in connection with the introduction of sound. They should not be compelled to defend themselves against wholesale criticism for results which are wholly beyond their control. . . . "

Ottawa Evening Journal:

'TWIXT STAGE AND SCREEN

By Will McLaughlin

"Patrons of sound equipped theatres and newspaper film reviewers—many of the latter are former dramatic critics whose artistic souls revolt against the use of dialogue in dramatic expression other than on the stage—have a tendency to place the blame on the boys in the projection booth when anything goes wrong during the unfolding of the picture on the screen. In other words, the prevailing impression among laymen is that the projectionist is wholly responsible for the results if bad, and deserving of no credit at all if good.

Requisites for Work

"This view, however, is unfair and entirely at variance with the real facts. The boys who manipulate the intricate sound apparatus and huge projection machines in the booths of our local theatres are of more than average intelligence, conscientious and diligent students of the new art of the screen. They have to be in order to possess the sound technical knowledge necessary to pass the severe examinations of their union and the additional regulations of the Government before being permitted to operate. No more are they mere moving picture operators, but members of a profession that is as difficult as it is important in present-day theatre operation—a profession of such importance that it justifies the pride which its members take in it.

Friendly Rivalry

"The editor of this department has frequently been made aware of the fine spirit of rivalry which exists among local projectionists in furthering the cause in perfect sound reproduction in the theatres to which they are attached. Consequently we are glad of this opportunity to help dissipate on their behalf some of the fallacies which exist among theatregoers in regard to inferior projection and defective sound which, more often than that, is due to inferior studio recording on film or disk, or to the fine hand of the Film Censor Board.

"Under the circumstances it is manifestly unfair to attribute all the blame for poor reproduction to projectionists."

Two Books you should have



Sound Projection - $6.00
Television - - - - $3.50
Combination Price - $8.00

SOUND PROJECTION

Thousands of copies of this book have been sold in the last several months. It has been acknowledged everywhere as the best treatment on the subject of sound picture projection.

It takes in all kinds of sound equipment, giving a complete explanation of the advantages of each type, how to operate it, what troubles may be expected and how to remedy them quickly and efficiently, how to maintain the equipment and how to get the best tone effects and to obtain proper acoustical conditions.

It is a book written especially for the theatre manager, the engineer and the projectionist. It is also of great value to the army of experimenters working on the improvement of sound picture equipment.

TELEVISION

The papers are full of stories about television. It is estimated by the most conservative authorities that we will have television for theatres within a very short time. Roxy says he wants it at once; B. S. Moss, veteran theatre operator, is building new theatres with provision for television apparatus.

This book, written for the theatre owner, projectionist engineer and technician, gives a valuable outline of the work already accomplished on Television, the scientific and mechanical background, its operation and practical usefulness in connection with motion pictures. It should be read and digested by every member of the theatre staff.

Fill in the coupon below, tear out and mail it at once to the Mancall Publishing Corporation, 45 West 45th Street, New York City. Please be sure to mention which one of the books you want or both and inclose the proper remittance. We will pay all postage. Shipment will be made within three days after receipt of order.

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New Equipment and Appliances

New Cue-Meter Ingenious Projection Room Aid

THE Cue-Meter is an instrument which shows the projectionist, at a glance, the exact number of feet of film from the changeover of the particular reel which is being projected. It is designed to be attached to the front wall of the projection room, near the operating side of each projector, and is connected to the shutter shaft by means of a flexible cable. It consists of a system of gearing, driving a pair of hands similar to those of a clock, which indicate the exact number of feet of film remaining in the upper magazine.

How It Works

The dial of the Cue-Meter has two scales, one within the other. The outer scale has 100 divisions, each equal to one foot of film. The inner scale has 25 divisions, each equal to 100 feet of film. The gear ratios are such that one complete revolution of the large hand causes the small hand to move one division on the inner scale.

After the projectionist threads a reel of film which has previously been measured from start mark to the changeover, he sets the small hand to the division on the inner scale of the meter corresponding to the 100-foot units as determined from the length of the film; and then sets the large hand to the division on the outer scale corresponding to the fractional part of the 100-foot unit of the film length.

In other words, assuming the length of the reel to be 1825 feet, the projectionist would set the small hand to division 18 on the inner scale and then set the large hand to division 25 on the outer scale. The meter *subtracts* one unit from the total for each foot of film run. Still using the above figures, we will assume that the projector runs down 25 feet of film. At this instant the small hand of the Cue-Meter will point to division 18 on the inner scale and the large hand will point to zero on the outer scale, thus indicating 1800 feet still to be projected.

Assuming that the projectionist allows ten feet of film on the outgoing projector, for the incoming projector to come up to speed, he simply watches the Cue-Meter until it indicates ten feet remaining in the upper magazine and then starts the incoming projector and makes the changeover at the instant the Cue-Meter indicates zero.

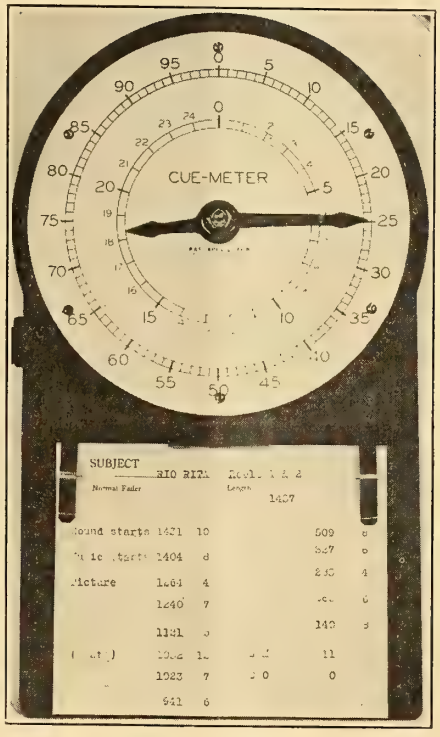
Curtain-Cues

The Cue-Meter can be used in the same way to indicate the exact point to close or open curtains. Knowing the time, in seconds, required for a curtain to close (if motor-driven), the projectionist multiplies this time by 1½ (number of feet of film projected per second) and starts the curtain motor when the Cue-Meter of the out-going projector indicates that number of feet still in the upper magazine. Example:

Curtain closes in eight seconds. Projectionist starts curtain motor when Cue-Meter of out-going projector indicates 12 feet.

Fader Cues

Preparing a complete fader cue-sheet is simplicity itself. During the rehearsal, or first show where rehearsals are not given, the projectionist starts each reel with the fader set at



New Cue-Meter

normal for that particular theatre. Then as the observer signals for a change in volume the projectionist makes the required change and at the same time makes a note of the Cue-meter reading. When the observer again signals, the projectionist makes another note of the fader setting and the meter reading. The next time this reel is projected the fader settings are changed when the meter indicates the footages before noted. Such cues can be read at a glance and are far more accurate than cues giving a description of the action or dialogue. A new shift of projectionists, who have not previously seen the picture, may come on duty and run a perfect show, with only the Cue-Meter and footage cues to guide them.

Re-Synchronizing

The Cue-Meter is also useful for re-synchronizing disc prints. When the film breaks above the top sprocket,, it is necessary to stop the projector, make a patch, rewind the film and start all over again. As an example, suppose the film broke above the top sprocket and the projector kept running for several feet before it was stopped. *Do not disturb the reproducer on the record.* Merely subtract the cue-meter reading from the total length of film. Then take the frame which has the footage number on the edge of the film which corresponds with the remainder derived from the above subtraction, thread it into the aperture plate and finish projecting the reel in the usual manner.

The Cue-Meter is also useful to indicate definite times to give Stage Warnings, Orchestra Calls, Arc Standbys, etc.

Lubrication

The Cue-Meter should be oiled regularly at three points. These points may be reached by removing the knurled screw at the top of the case permitting the case to swing down and exposing the mechanism.

Place *One* drop of projector mechanism oil in each of the three oil holes, about once every twelve hours of operation.

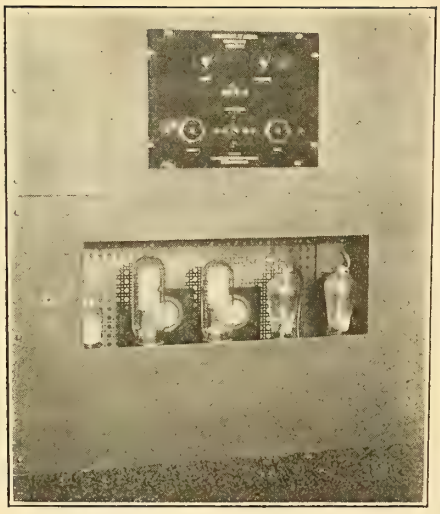
The flexible shaft should be removed from its housing about twice a year and given a coating of graphite chain lubricant.

Do Not Clean the Dials with Film Cement. If they become soiled they may easily be cleaned with soap and water.

The Amplion Type PA-50 Power Amplifier

The Amplion Type PA-50 Power Amplifier is the latest accomplishment of the Amplion laboratories. This amplifier is made under the Loftin-White patents, plus some other new developments from the Amplion laboratory. These features cannot be disclosed at present, due to patent reasons.

These new inventions have made it possible to modulate two 50-watt power tubes with one type-224 radio tube, the 224-tube operating directly from the standard phonograph pick-up. The actual gain of this amplifier has not been measured at this time, but the two 50-watt tubes are driven at their full wattage capacity by the type-224, which, when in operation, is



Amplion PA-50 Amplifier

excited by the standard phonograph pick-up.

It has raised the standard of quality in the reproduction of all forms of sound. Through the new developments it is possible to retain the high standard of quality and yet manufacture this big amplifier to sell at a list price of $700.00 and at the same time allow standard trade discounts.

An announcement to be made shortly will show a unique and sensational installation, wherein this new amplifier is used in conjunction with the new Amplion 12-foot exponential horn speaker.

Disc vs. Film

Following its recent acquisition of certain interests in the Theodor H. Nakken sound-on-film patents, Warner Bros. Co., was reported as set to drop their Vitaphone recordings and in future release their product on sound film exclusively. Considerable speculation and inquiry on the possibility of such a move brought the answer from Warners that "as far as Warner Bros. is concerned, sound-on-film does not exist." This comment, while reassuring, is not generally regarded as the last word on the matter.

Should Warners really go through with the idea of supplanting discs with sound-on-film, the disc business would be pretty much brought to a standstill. There has been much recent comment on the relative merits of each process, particularly at the Spring Meeting of the S. M. P. E., but the facts marshalled in support of either argument were not of sufficient importance to definitely settle the question. Disc is generally admitted to afford the best sound reproduction, but the cost of the process is regarded as permanently barring its adoption as standard.

Warners are known to have long been on the hunt for certain patent rights with which to fortify its position in the sound field. The purchase of the Nakken patents is a step in this direction. Then, too, Harry Grinnell Matthews, noted English inventor, recently spent several months in this country and was reported to be in Warners' pay as an agent working to "bust wide open the patent situation."

Warner is more or less a lone hand in these patent moves, as the balance of the producers are regarded as being satisfied with existing W. E. tie-ups on recording and reproduction. Warner independence in these matters has long been known.

J. J. F.

Sees Improved Film

Discovery of an accidental impurity which is largely responsible for the sensitiveness of film and the eventual possibility of improved projection via its elimination is seen here in the talk made by Dr. C. E. K. Mees, director of research for Eastman Kodak, before the Canadian Chemical Society.

The impurity, he explained, was found in the gelatin from the skin of animals and had been traced to the consumption of plant life. It is a compound containing sulphur.

While a film projected on the screen appears smooth to the naked eye, the surface of the projected picture contains millions of microscopic crystals, Mees said. More of these crystals are to be found in a square inch of film than there are human beings on earth, he pointed out.

Color Sensation

The nerve fibers of the eye which carry the sensation of color to the brain are particularly sensitive to the primary colors—red, yellow, and blue. Indeed, all color sensations are produced by the stimulation of three sets of nerves which are sensitive to the primary colors.

If one sees purple, it is because the optic nerves sensitive to red and to blue (purple equals red plus blue), have carried their separate messages to the brain, and the blending of the two distinct messages in the brain has given the sensation of purple. If a red rose is seen, it is because the optic nerves sensitive to red have been stimulated and have carried the message to the brain.

A snowy field stimulates equally all three sets of optic nerves—the red, the green, and the blue. Lavender, which is one part blue and three parts white, would stimulate all three sets of nerves, but with a minimum of stimulation for the blue. Equal stimulation for the three sets of nerves would give the impression of white.

A color-blind person has some defect in one or more of the three sets of nerves which carry the color message to the brain. Suppose the nerve fibers responsible for carrying the red are totally defective:—under these conditions a person viewing a yellow flower would see it as a green flower.

Tube Coating Puzzles

It is often necessary to explain that the density of the silver-like coating in vacuum tubes has nothing whatsoever to do with the performance of the device. This coating is not silver but magnesium, and its presence is necessary to insure a high vacuum.

Before the air has been exhausted from the tube in the factory the glass is perfectly clear. After pumps have removed as much air as possible the stem is sealed and the tube is placed in a radio-frequency furnace.

This machine, as its name indicates, produces heat which causes a small quantity of magnesium placed inside the tube to explode and be deposited on the inside wall of the glass. This process consumes all undesired gas which had not been removed by the pumps.

Musicians Lose $20,000,000 Yearly

Musicians' income has been cut about $20,000,000 per year as a result of the inroads of sound pictures into the amusement field, according to a statement issued by President Joseph M. Weber of the A. F. of M. at the last convention in Boston. The A. F. of M., which has some 140,000 members, is actively backing the Music Defense League which has for its aim the "abolition of mechanized music." The League reports much progress in its drive to win public sentiment over to its demand for employment of musicians.

Electric Chemical Separation

Many chemical analyses, basic processes in every industry, depend upon the detection of color changes, the more elementary among which are the shade variations of "indicators" used to show whether a solution is alkaline or acid or when these two chemical conditions neutralize each other. Walter Krahl, Chief Engineer with the Arcturus Radio Tube Company, Newark, N. J., describes apparatus under development in the Arcturus laboratories which will supplant the human eye in checking these determinations.

"As we all know," says Mr. Krahl, "the sensitivity of the human eye to color changes varies with the individual. Some of us are color blind. Such persons are unable to discriminate among delicate color changes. To a mild case of color blindness, pink and yellow appear the same color, and so do blue and green. A bad case of color blindness sees "photographically"—that is, everything appears like a photograph, in varying shades of black and white. Many people are color blind without knowing it, and often hold down positions where a certain degree of color discrimination is desirable or even necessary.

"An artificial eye, however, employing the photoelectric cell, can be designed that is sensitive to color changes which even the normal eye cannot detect.

Everyday Science

Forecasts Hurricanes From Drop in Power of Sunlight

THE possibility of forecasting tropical hurricanes, like those which occasionally strike Florida or Cuba, by watching for sudden decreases in the intensity of sunlight, which decreases are believed to precede such hurricanes and to cause them, is seen by Mr. Herbert Janvrin Browne, consulting meteorologist, of Washington, D. C. Collecting from weather records all available instances of West Indian hurricanes, North Pacific hurricanes or "typhoons," cyclones in the Bay of Bengal and the Australian storms called "williwaws" occurring between 1908 and 1929, Mr. Browne compared these hurricane dates with the values of the "solar constant," which measures the intensity of sunlight, for six days before and after the day on which each hurricane apparently began.

Browne's Theory

"The weight of evidence is overwhelming," he concludes, "that during the hurricane seasons marked drops in solar radiation precede at short intervals and bring on West Indian and other hurricanes of the tropical and subtropical oceans in zones of calms, low rainfall and high surface temperatures."

To use this relationship practically in order to forecast such hurricanes farther in advance than is now possible one need not understand precisely why sunlight and these storms are related. Mr. Browne has formulated, however, a theory that intense sunlight tends to increase the stirring of the air over the danger spots in the oceans where hurricanes are likely to start so that any excess of energy is dissipated before it can become dangerous. If the intensity of the sunlight decreases, this atmospheric safety valve may quit working and allow excess energy to accumulate until it starts a hurricane.

Find Sunset-Colored Glasses Keep Flies Out of Rooms

An aversion of house flies to red or yellow light, discovered by experts of the Crown Glass Works of Pilkington Brothers, Limited, at St. Helens, England, is attracting attention among British entomologists not only as a promising means of keeping flies away from food storerooms and similar places but probably as an example of the way that evolution has fitted the habits of these insects to the conditions of their environment.

In consultation with Professor Robert Newstead of Liverpool University, the Pilkington experts set up experimental rooms the windows of which were made of white glass, red glass, yellow glass, blue glass and glasses of other colors. Flies gathered more numerously, it was found, in the ordinary white light admitted by colorless windows than in light of any other color. Blue and green glass made relatively little difference, the insects invading blue-lighted or green-lighted rooms in virtually the same numbers as were found in white-lighted rooms.

Red and Yellow Repels

Red and yellow glasses, however, attracted notably fewer insects, leading the experts to conclude that red or yellow light is for some reason repellent to the flies. That yellow window glasses might serve to keep flies out of rooms not otherwise protected is a practical suggestion. The suggestion relating to evolutionary theory is that perhaps the habit of these insects to avoid red or yellow light is related to their custom of hiding away out of sight during the night.

Reddish or yellowish light perhaps indicates to the fly the tinge of sunset and the approach of the hour when it is necessary to seek a nighttime hiding place.

Earth Electricity May Explain Day and Night Rhythms

Observations which may supply a clue to the mysterious cause of the day and night rhythms known to exist in plants and animals, many of which rhythms persist even when the creatures concerned are placed in dark rooms away from every indication of daylight or darkness, are reported by Professor Fernando Sanford, of Sanford University, Calif., in the latest bulletin of his Terrestial Electric Observatory.

Twice a day, Professor Sanford discovers, electrically insulated objects near the earth's surface change electric voltage by an amount equivalent to about 200 volts. During the day such insulated bodies are electrically positive; during the night they are negative. Delicate electric instruments set up to test these effects showed an electro-positive repulsion between loose insulated objects in the daytime and a similar but electro-negative repulsion at night. Both plant and animal bodies probably contain, physiologists believe, structures more or less perfectly insulated electrically.

Daily Electric Changes

It is not unreasonable to imagine that these structures may be sensitive to the daily electric changes which Professor Sanford has discovered, so that some animals might continue to take their nightly sleep and some plants to close their leaves as they do in darkness, even when kept in continuous light. Similar unconscious effects of this daily reversal of electric charge are perhaps responsible for the fact that most human beings sleep more soundly at night than in the daytime, even when noise and light are excluded.

The daily variations of electric charge are caused, Professor Sanford believes, by interaction between vast electric charges on the sun and the earth, the effect of the sun's charge being to repel the negative electricity of the earth so that the planet's sunlit side becomes relatively positive while the dark side is relatively negative.

Lightning Protector

A lightning protector is an electrical safety valve. The duty of the protector on an electrical system is to relieve the system of abnormally-high voltages, in a manner somewhat similar to the way a safety valve relieves a steam boiler of an excessively-high pressure. Just as the safety should stop the escape of steam after the abnormal conditions have been relieved, so should a lightning protector stop the flow of current after the high potential has been relieved.

Thus any device which will, under the influence of a voltage above normal, permit current to flow through it and which will, when abnormal conditions cease to exist, stop the flow of that current, constitutes a lightning protector.

Old Men Have Better Eyes But Worse Ears

Forty-five is the dangerous age for men's eyes and ears if not for the rest of their bodily equipment, according to studies made recently by the Research Division of the Milbank Memorial Fund, of New York City, on 100,000 records of physical examinations accumulated by the Life Extension Institute. All of these 100,000 individuals, the statisticians of the Fund report, were over 25 years old, white, native-born Americans. Many occupations were represented, most from the better-paid and more highly-placed classes. Among individuals between 25 and 40 years old, the statistics indicate, eye defects were found in from 19 to 24 per cent of the persons examined.

40 the Critical Age

A year or two beyond forty the percentage of such defects increases sharply, so that over half of the men of 50 are found to have defective eyes. A curious point is that the percentage

of eye defects in very old men actually decreases, probably meaning that persons with good eyes are a little more likely to live beyond 60 or 70 than are men with eye defects. Some eye defects probably result from general bad health also apt to cause earlier death.

The statistics of defective hearing show a similar sudden rise in men of 40 or 45 but no decrease at 60 or 70. Among men between 25 and 40 defective hearing is found in less than 10 per cent of the persons examined. Between 40 and 60 the percentage of ear defects increases rapidly, so that about a third of the men of 60 have something wrong with their ears. At greater ages, instead of decreasing in percentage as eye defects do, the ear defects increase still more sharply, so that nearly half of the men of 70 are partly deaf.

Noise Causes Unpleasant Stomach Reaction

Balloons in peoples' stomachs to record what happens to that part of the human digestive apparatus when the ears are assaulted by a loud noise, were described by Mr. E. L. Smith, of the psychological laboratory of Colgate University, Hamilton, New York, before the recent meeting of the Acoustical Society of America at the Westinghouse Lighting Institute in New York City. It had been suspected, Mr. Smith explained, that one effect of loud noises on human beings is to create an unconscious "fear reaction" which may have important mental or physical results. Previous experiments had indicated, also, that fear or any other sharp emotional reaction often affects the rhythmic contractions of the stomach which go on more or less continually so long as that organ is in good health.

To test these effects in the case of noises Mr. Smith arranged, under the direction of Professor Donald A. Laird, already known for his studies of the psychological effects of noise, to have each of four individuals swallow a small rubber balloon which then was distended with air and connected to a registering apparatus so that every change in the size or tension of the stomach could be recorded.

When a loud noise was produced in the room, Mr. Smith told the society, the stomachs of some of his subjects contracted sharply, like a suddenly closed fist or like the muscular jump or "start" which some people give when surprised. Others of the individual stomachs, on the other hand, relaxed suddenly when the noise was heard. In all cases, however, the momentary contraction or relaxation was followed within a few moments by a decrease in the speed of the rhythmic stomach contractions and by changes in their intensity.

The experiments must be extended before sure conclusions can be drawn but it is probable, Mr. Smith's observations suggest, that noise might affect the stomachs of some people sufficiently to cause indigestion.

Disc Troubles and Their Remedies

VERY often really serious trouble is encountered in sound reproduction that might be easily overcome were the symptoms of the trouble familiar to the projectionist and the remedy charted. The following abstract from the maintenance files of the Projection Department of a major exhibiting organization cites the more common troubles experienced with sound reproduction from discs and should prove particularly interesting to projectionists.—The Editor.

1. *Complaint:* Repeating record; muffled and indistinct sound.

Cause: Needle assembly of reproducer leaning far to one side; turntables not anchored, but resting on blocks of wood and wobbling as though warped.

Remedy: New arm and reproducer, because assembly was one unit and could not be straightened by adjustment; also, anchoring of turntables.

2. *Trouble:* Tone too "barrelly."

Cause: Overweighted tone arm that was not passing the high frequencies.

Remedy: Trouble was partially overcome by use of half-tone instead of full-tone needles. When even better results were desired, a new and better balanced tone arm was installed.

3. *Complaint:* Bad records, causing the needle to jump.

Trouble: Tone arms adjusted so that needles were riding records at an angle of 45 degrees; also, lead tape wrappings on tone arm heads which increased their previous overweight by 1½ pounds.

Remedy: Building up the tone arms to the proper angle and also moving lead tape wrappings from front to the back of arms to give better balance.

4. *Complaint:* Record so poor that it would not run without jumping.

Trouble: Use of reproducer with adjustable tone arm and with weight so far on end that the needle was gouging and, at certain frequencies, hurdling the grooves.

Remedy: Adjusting tone arm weight to materially lighten needle pressure; and the substitution of half-tone for full-tone needles.

5. *Trouble:* Repeating of all records.

Cause: Tone arm so stiff and rigid that it had absolutely no play and could not possibly follow grooves at high frequencies, even with half-tone needles.

Remedy: Replacement of tone arm with one of proper flexibility. As a temporary expedience, projectionist was shown how to guide needle by hand.

6. *Complaint:* Records so warped that it was impossible to run them.

Cause: Warping was very slight, and only in one new record of one set. Still, it was enough to cause jumping at high frequencies when full-tone needles were used.

Remedy: A half-tone needle tracked perfectly, even at the high frequencies in the damaged, warped record. Nor was there any trouble with the same record of the substitute set when it was played with half-tone needles.

7. *Complaint:* Defective record, with needle jumping and repeating.

Trouble: Considerable vibration in turntable which, with use of full-tone needles, was causing jumps at points of high frequency recording.

Remedy: Trouble was entirely overcome with a decided improvement in sound quality by changing to half-tone needles.

8. *Trouble:* Tone quality not satisfactory.

Cause: Needle riding too much on side of groove, causing flutter and fuzziness; also, horns not baffled.

Remedy: New arm. Old arm could not be adjusted because threads of the set screw all had been stripped. Horns were baffled.

9. *Trouble:* Unsatisfactory tone quality (new installation not yet used for public show).

Cause: Pick-up head of one arm was frozen, the armature being almost stuck against the magnet, so that a narrow range of tones was passing; also one very bad tube in amplifiers.

Remedy: New head for reproducer arm and new tube.

10. *Trouble:* Bad records, poor tone quality, jumping.

Cause: Tone arm overweighted and with a great deal of side play, causing the needle to chip the groove walls and produce distorting and blasting.

Remedy: Removal of five ounces of weight from tone arm and tightening of adjustments.

11. *Trouble:* Repeats and cut-overs; five sets of discs used on one production.

Cause: Two machines with reproducer arms of different lengths; needle drifting to inside of disc because machines were not levelled.

Remedy: Replacement of arms and levelling of machines.

12. *Trouble:* Needles jumping groove.

Cause: Pick-up arm has no diaphragm and uses an armature which lacks the flexibility to follow a high range of volume recorded in the spiral of a disc.

Remedy: Substitutions of half-tone needles for the full-tone needles which were being used.

13. *Trouble:* Needle jumping groove.

Cause: Weight of the arm too great for certain frequencies.

Remedy: Lightening of needle pressure on record.

Sound Recording Technic

(*Continued from page* 21)

tween the ear and eye is maintained. The insistence on this requirement on one of the early pictures made led some humorist to call this technic "The Trail of the Lonesome Mike."

It should be noted from previous paragraphs: one microphone position only for one camera position. There are some cases involving complicated setups, where closeups and long shots are being attempted simultaneously, where more than one microphone may be legitimately in the set at one time, but only one of them should be on at any given time. The one that is on, naturally should correspond with the camera whose picture is to be used in the final cut. This use of closeup and long shot simultaneously, requires a knowledge of how the scene is going to be cut, and should, therefore, be avoided if there is any doubt about cutting.

During one of the first pictures that was made with this technic, the studio people were coaxed into making the sets with sufficient reverberation to produce the depth effect. The set in question was about 25 or 30 feet wide and some 35 feet long and approximately 24 feet high. It represented a large hall in an old-fashioned European home, and there was an entrance onto a stairway from a second-story room at the back of the set. The dialogue was started in the middle foreground by a man, and then a young lady came out of the second-story room and said a few lines, the dialogue continuing until both people were at the foot of the stairs midway back in the set.

Long and Short "Shots"

The studio people insisted on making a closeup and a long shot simultaneously, and as the long shot covered a considerable angle, it was impossible to get a microphone into the scene sufficiently near the young lady to take care of a sound track for her closeup at entrance. When the rushes were shown in the review room, the first to come through was the long shot, and the result was exceedingly good, the voice appearing to come from the mouths of the speakers. The second rush showed the long shot scene with the closeup of the young lady cut in at the proper place. This picture, however, was coupled up with the only sound track available, namely, the long shot sound track. Of the five people in the review room, three unconsciously moved their heads to one side to see around the girl, in order to find out who was speaking in the room behind her. The effect was so disconcerting that it was necessary to retake the closeup with its own sound track.

Since the interpretation of distance by the microphone depends upon the acoustic properties of the set, there is only one microphone distance at which the proper sound distance will be obtained. This is analogous to limiting the cameraman to a single lens for his camera. Hence, when a change is made to a long focus lens, it is necessary to move the microphone nearer the scene than was necessary for the shorter focal length.

(*To be continued*)

Enroll 900 For Second Term of RCA School

WITH 900 members of projectionists locals from Manhattan, Long Island, Eastern New Jersey, Southwestern Connecticut and other nearby sections enrolled, the second semester of the course of study in operation of sound motion picture equipment being conducted by RCA Photophone, Inc., at its installation and service department, No. 438 West Thirty-seventh street, began on April 21st.

Of the two hundred and fifty mem-

(*Continued on page* 50)

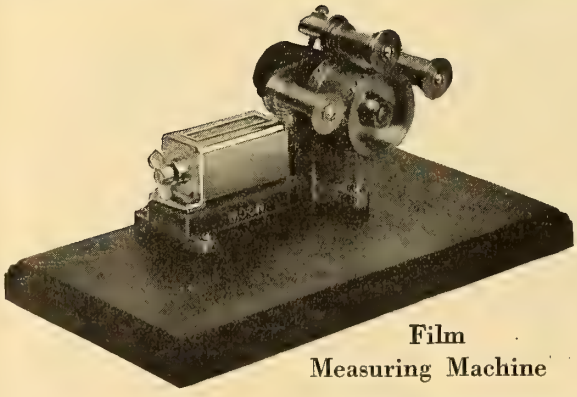
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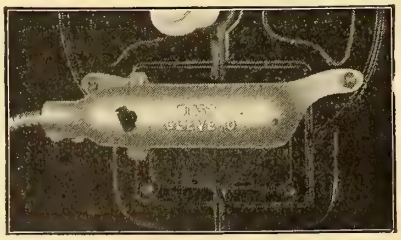
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Theatre Sound Reproduction

(*Continued from page* 15)

tion, as has been shown above, considerations of efficiency favor the horn type of loudspeaker only to a slight extent.

Summary

The above results can now be summarized as follows. In power handling capacity the two speakers are about the same. In efficiency the horn type speaker is somewhat superior. The directional characteristics of both types are satisfactory. As regards frequency response characteristics, the directional baffle type speaker is markedly superior to the horn type in the reproduction of both speech and music. On the basis of these factors it appears quite conclusively that for theatre reproduction, of the commercial devices in use at the present time, the directional baffle type loudspeaker yields more satisfactory results.

Discussion

Mr. Rider: Does this paper deal with two types of speakers driven by the same motor or with each of the speakers as a complete unit?

Mr. Malter: In considering the reproduction of speakers one cannot consider merely the characteristics of the component parts but must consider the characteristics of the reproducing system as a whole, since the various units exercise an influence on each other. The purpose of this paper has been to compare the characteristics of the two most widely used types of complete units. As I pointed out, on the basis of the measurements the directional baffle type speaker is the louder. The directional baffle and the horn type do not allow the same driving unit to be used owing to differences in construction.

Mr. Fletcher: The first question I want to ask is whether these measurements were made on just one horn type and one baffle type, or were ten or twenty used? I know that we have found the variation from one type to another is almost as much as was shown. Why did you pick the particular ones you did? The second question is, on what was your statement based that one had better naturalness? Was it a matter of opinion or were measurements made? The third question concerns the statement that you get the same understandability of speech because the frequency response between 300 and 4,000 is the same. We have made measurements on this which show there is a difference in the understandability of speech, so that if the tests were made carefully that would have been shown by articulation tests.

Mr. Malter: To answer the first question as regards the number of

speakers, employed in the tests: these chosen were chosen by listening tests of these types all of which gave practically the same quality of reproduction. As regards the point as to which types were chosen, we chose the speakers of each type most widely used in the theaters and not those having a relatively small distribution. As regards the question on the subject of naturalness, this is a factor which is to a large extent subjective. Measurements of this factor cannot be made very accurately in an objective fashion, and the conclusion as to naturalness is the result of the impartial observation of a large number of observers. With regard to articulation, the measurements do indicate practically identical articulation. The effect of frequencies of 4,000 cycles is not in agreement with the results published by Mr. Fletcher in his book on "Speech and Hearing."

Mr. Malter: For correct reproduction we should reproduce all frequencies, and the greater the frequency range, the greater the naturalness. In that respect, as I pointed out, the directional type of speaker has the edge.

Mr. Braun: Were any tests made showing at what point either of the two types of speakers introduce distortion?

Mr. Malter: No careful tests were made on that point.

Mr. Lawley: May I ask what the size of the final opening of this directional baffle was?

Mr. Malter: Five feet by three feet.

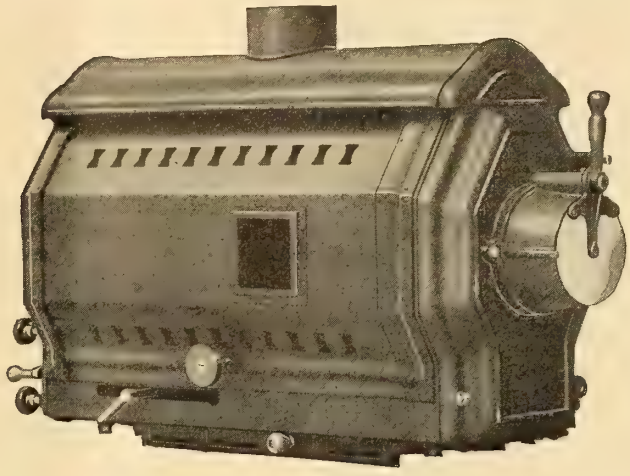
Mr. Lawley: Was the horn the same size?

Mr. Malter: Approximately. I have the figures with me and can let you have them.

Mr. Maxfield: In regard to the matter of the speech of men and women sounding alike, I have heard a lot of recording reproduced on both speakers, but I have never heard a good record which resulted in such uncertainty on any speaker. In the early days, bad acoustics on the set flooded the market with records in which it is difficult to differentiate between men's and women's voices, but that is dying out. As regards the practical cut-off of the horn type speakers, those with which I have come in contact give trouble at times with the 60 cycle hum. The horn type of speakers at least produced audibility down to 60 cycles.

Mr. Malter: I agree with Mr. Maxfield that poor recording sounds bad on any type of speaker and good recording will improve the response from any speaker. Our results are not only on reproduction in theaters but on listening tests with a high quality amplifier and condenser microphone, and it is on the results obtained in theaters and from the listening tests that the conclusions were drawn.

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Service Keeps Pace with Installations

By H. M. WILCOX

Operating Manager, Electrical Research Products

THREE years ago our entire technical staff totaled less than 50 engineers. Their equipment consisted mainly of a pair of pliers and what they carried under their hat. No wiring diagrams, no operating instructions, no testing instruments and no test films or records were available. With the growing volume of work, which now amounts to servicing 4,000 Western Electric equipped theatres in the United States, we had to organize to train men for this work. It was easy enough to find people who could tell that something was wrong. In fact, the majority of movie audiences could tell that. But it was another matter to put together an organization of several hundred men who could diagnose the disease and prescribe and apply the remedy.

We established schools where, among other things, we deliberately injected troubles into the sound system—all the troubles we could think of—and required our students to clear these troubles. Owing to the rapidity of our expansion it was necessary to obtain men with extensive previous experience in handling electrical communication apparatus, both telephone and radio.

Service Requisites

But the mere training of the men was not enough. It was necessary to equip them with complete sets of wiring diagrams showing the circuits of every piece of apparatus. That, in itself, was a task. It required 200 drawings, necessitating the full time work of a large staff of draftsmen for several months. Even today the constant services of several draftsmen are demanded to keep these drawings continuously up to date. Every one of our engineers was furnished with test films and records of standard high quality recording so that the performances of the reproducing equipment could be accurately judged.

The question of communication between the theatre manager and our field engineer presented another intricate problem. Time was a prime consideration. When trouble does occur it must be remedied with the loss of as few minutes as are necessary. Program interruptions mean dissatisfied customers and lost patronage. From the time of our inception we began organizing branch offices and service stations from which our field engineers were to operate and where they could be reached at any time of day or night and where, also, adequate supplies of spare parts were to be maintained. Today we have offices in 40 cities of the United States, carry an inventory of a half million dollars of parts, maintain 600 trained engineers, within short call of nearly every theatre in the country and have resident engineers in 200 cities and towns besides.

The result is evident in the fact that in December, 1928, with approximately 1,000 theatres operating with the Western Electric Sound System we received slightly over 1,000 emergency calls, an average of one per theatre during the month. In March, 1929, with 4,000 theatres, we received less than 700 emergency calls, an average of one to every 5.7 houses. This is a fair indication of how the steady operation of the service department has, in 15 months, helped to assure program continuity.

One Remarkable Record

One remarkable instance that occurred was that of the Blackstone Theatre in Detroit, Mich., which ran 24 hours a day for seven days of the week for a solid year with only one interruption of five minutes. The result was obtained by a combination of first-class operation by the house staff, and constant servicing by our engineers. Without these two no equipment in the world could ever have withstood the strain of such a "marathon" grind.

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New Vitaphone Disc Size

A great majority of Vitaphone records for all film subjects for the coming season will be on 12-inch instead of 16-inch discs, according to an announcement by Warner Brothers Co., of which Vitaphone is a subsidiary. Warners state that this reduction in size will effect a tremendous saving to exhibitors, running up to as high as 50 per cent.

This change is expected to go into effect immediately.

Managers Get Technical Data

THE following pertinent questions and answers on projection matters were recently sent out to all managers of Publix Theatres as an aid in formulating a more comprehensive understanding of the technical details associated with the management of a theatre:

Q. In ordering lamps, what four essentials must be specified?

A. Type and shape of bulb, wattage, voltage, color-base type.

Q. What three factors determine the quality of lamps?

A. Cost, life, lumen outfit.

Q. What is the average burning life of a lamp?

A. 1,000 hours.

Q. To what lamps does this average not refer?

A. Spot lamps and projection lamps which burn 200 hours and 50 hours respectively.

Q. What is the average color permanency of the different colored lamps?

A. Natural colored most permanent. Dip and sprayed lamps—poor permanency.

Q. Why is it not cheaper to use lamps whose life is longer than standard lamps?

A. Although the life of the lamp is longer, more current is used giving less illumination and lower efficiency.

Q. What lamps should not be burned base up or at an angle?

A. All Mogul based lamps, spotlight lamps, and projector lamps.

Q. Are all natural and sprayed lamps of the same standard type and color identical in color?

A. No.

Q. Why is money wasted in using projector lamps for spot lights?

A. Shorter life at higher cost.

Defective Splices

Q. What types of splices are defective and why?

A. (a) Splices so wide that they cannot follow the curve of the roller. Splices with this defect will be carried through the top rollers and through the intermittent, but will run off the bottom roller leading to the magazine. Several frames will be damaged before the idler will set the film back on the sprocket. On the screen, the defect will show up as a bad jump.

(b) Splices which have been scraped too much, which have been fastened with too much cement, or those having both defects. The film will buckle resulting in the same action described above.

(c) Splices which have been mismated so that sprocket holes do not register. As the sprocket passes over the top roller, the teeth will enlarge the sprocket holes. The film will remain on the teeth as it passes over the intermittent roller but there will be a slight displacement resulting in a jump on the screen. At the take-up it will run off the roller causing damage to several frames. A defective splice will break occasionally at the intermittent interrupting the run of the reel, and showing on the screen a flash of burning film.

Fire Prevention

Q. What steps must be taken to insure fire-safety in the projection room?

A. Pail of water and pail of sand must be on the wall ready for instantaneous service. The Pyrene extinguishers should be handy to each projector. The fire drops and shutters should be closed every night and tested periodically. Film when not in use should be kept in metal containers with air holes to prevent the accumulation of explosive gases.

Future of Color

We are wondering what will happen during the coming year in the development and use of color in the picture industry. For a time it seemed as though color would completely, or nearly, wipe out black and white photography.

Black and White Favored

Now, however, there seems to be a gradual change back to black and white. This is partly due to inability to get sufficient release prints in a short time. Will this stop the advance of color? After all, the prize of the Academy of Motion Picture Arts and Sciences for outstanding photography went to a picture in black and white. Time will tell.—*American Cinematographer.*



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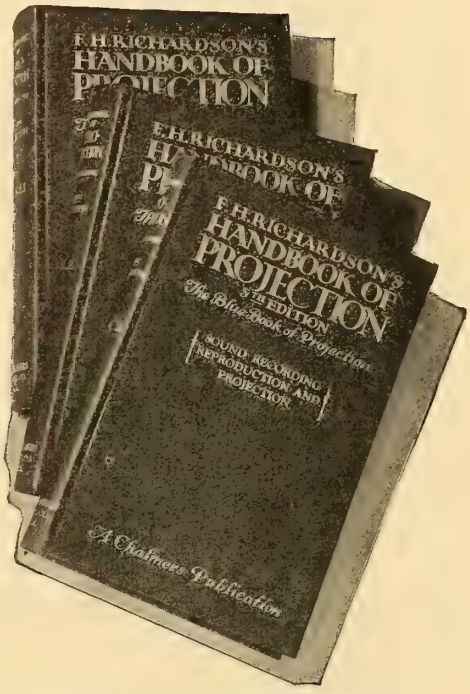
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Progress P A C *Through Understanding*

THE tremendous success of the Projection Advisory Council within the past year has demonstrated the marvelous potentialities of this body as a force for much good in the interests of projection and projectionists. Leaders in every branch of the motion picture industry have lauded the work of the Council, and have predicted for it a long and useful life. President William F. Canavan of the International Alliance has endorsed the aims of the Council and has expressed himself as being highly gratified by the work already accomplished by it.

The amount of good work that can be done by the Council is limited only by the size of its membership and the cooperation tendered the Council by that membership. The Council is your organization, Mr. Projectionist, and its efforts in your behalf will be an accurate reflection of the support you give to it.

In order properly to expand the activities of the Council, an increased membership is desirable at the present time. The membership books of the organization will be kept open until September 15th next for the enrollment of new members.

Projectionists, and all those interested in the advancement of projection, are therefore urged to avail themselves of this opportunity to apply for membership in the Council. Use the blank below to help those who are helping you.

LAURENCE JONES, *Secretary,*
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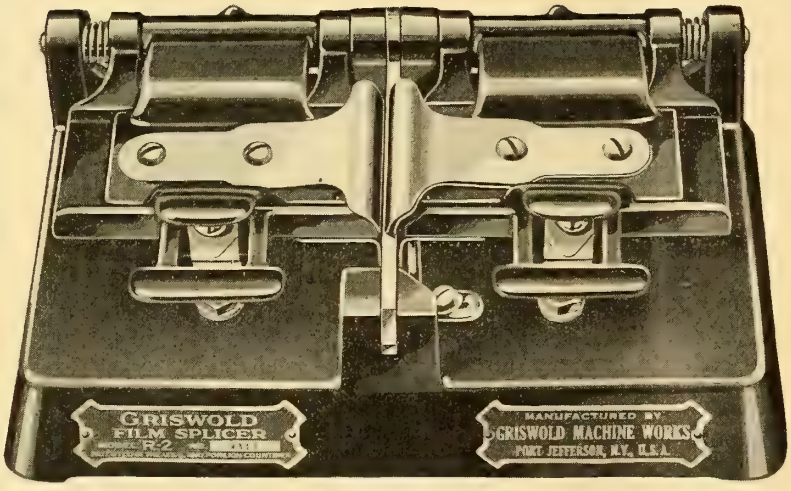
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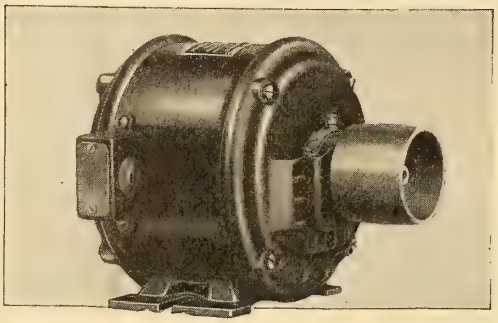
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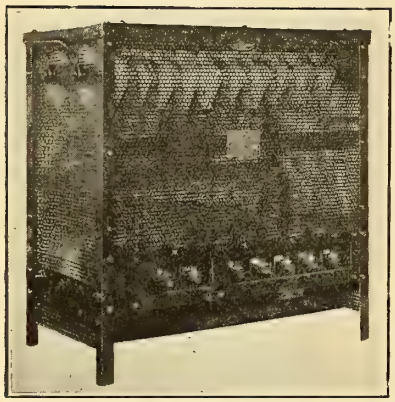
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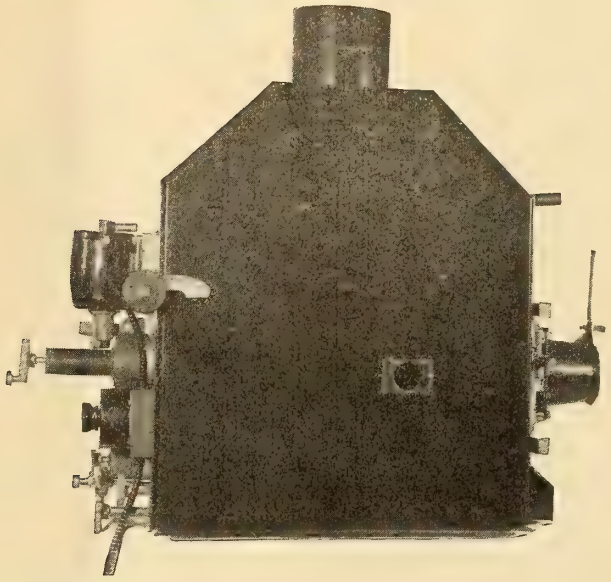
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RCA Sound School

Continued from page 39)

bers of Local No. 306, New York City who attended the classes during the first semester, sixty re-enrolled for the second course. Classes are held daily from 10 to 12 in the morning, 1 to 3 in the afternoon and 8 to 10 in the evening.

About thirty students attend each session. Lectures are delivered by Harry Braun, A. R. Schultz, A. Preisman, Watson Jones, and Edwin Costello, each of whom has had broad experience in connection with the operation of sound reproducing equipment.

Text books have been prepared under the direction of H. E. Costen who has been assisted by four other experts. These text books contain authorative information upon the subject of sound reproduction and the care and maintenance of sound reproducing equipment. In addition to the lectures and the text books, the instructors give practical demonstrations of the operation of the various types of sound reproducing equipment with which the lecture room is amply supplied.

A completely equipped projection room with two sound reproducing projection machines, operating with sound-on-film and disc form a part of the equipment used in connection with the class work.

Represented in the class are projectionists from Stamford, Hartford, and Bridgeport, Conn.; Newark, Perth Amboy, Jersey City and Paterson, N. J.; about twenty cities and towns on Long Island; Mt. Vernon, New Rochelle, Nyack and New York City. Applications have been received from various other cities, among those from a long distance being Atlanta and Los Angeles.

Harry Braun who has been acting as chief instructor of the RCA Photophone course, recently delivered a talk on sound reproduction to the members of Local 650, Mt. Vernon, and at the conclusion of his talk the entire membership comprising about 100 men, enrolled for the second course.

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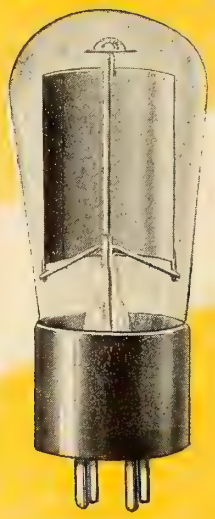
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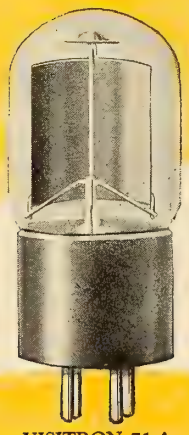
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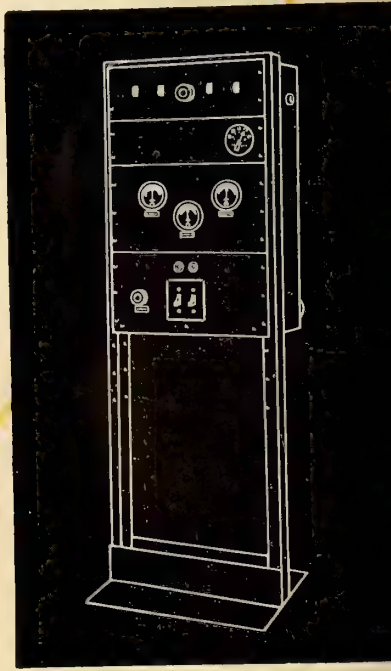
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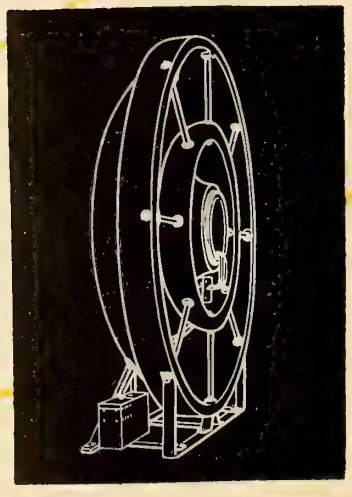
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AUGUST, 1930

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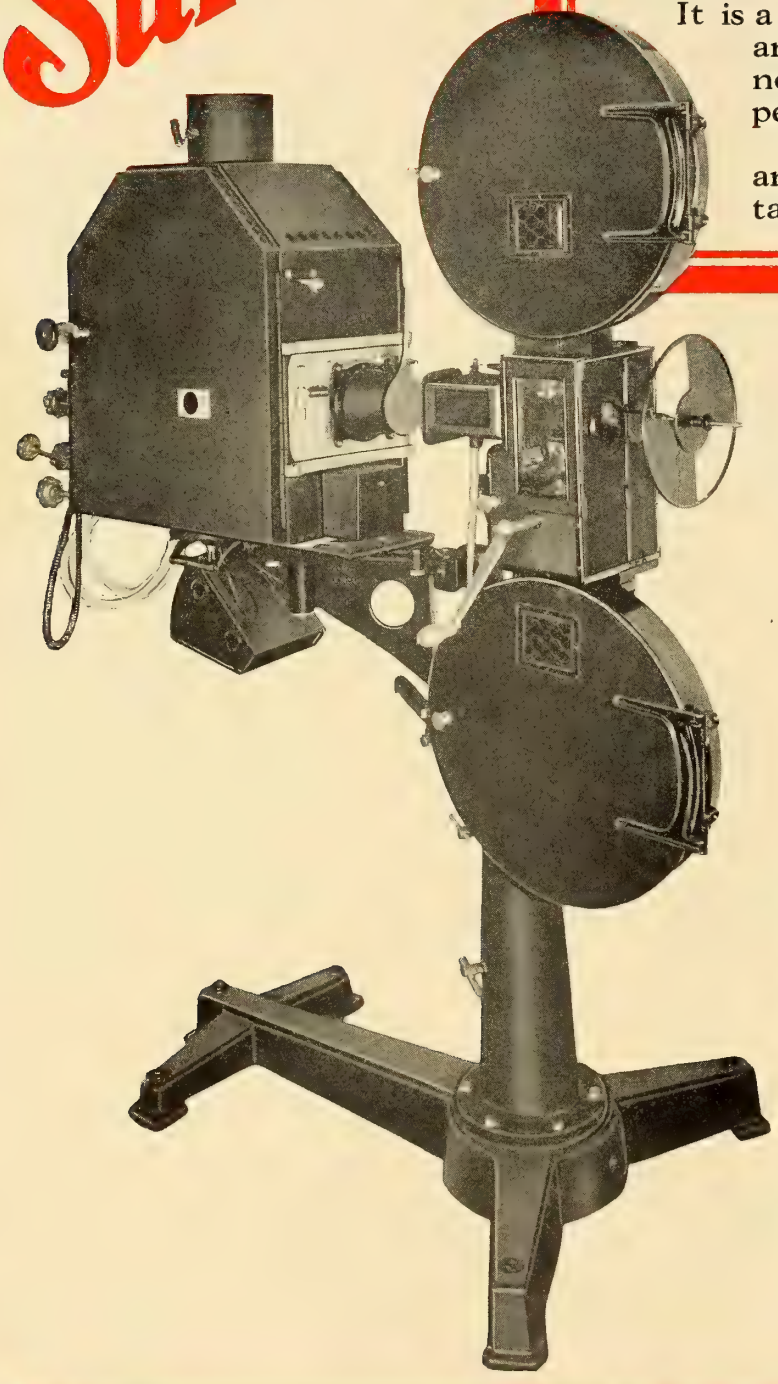
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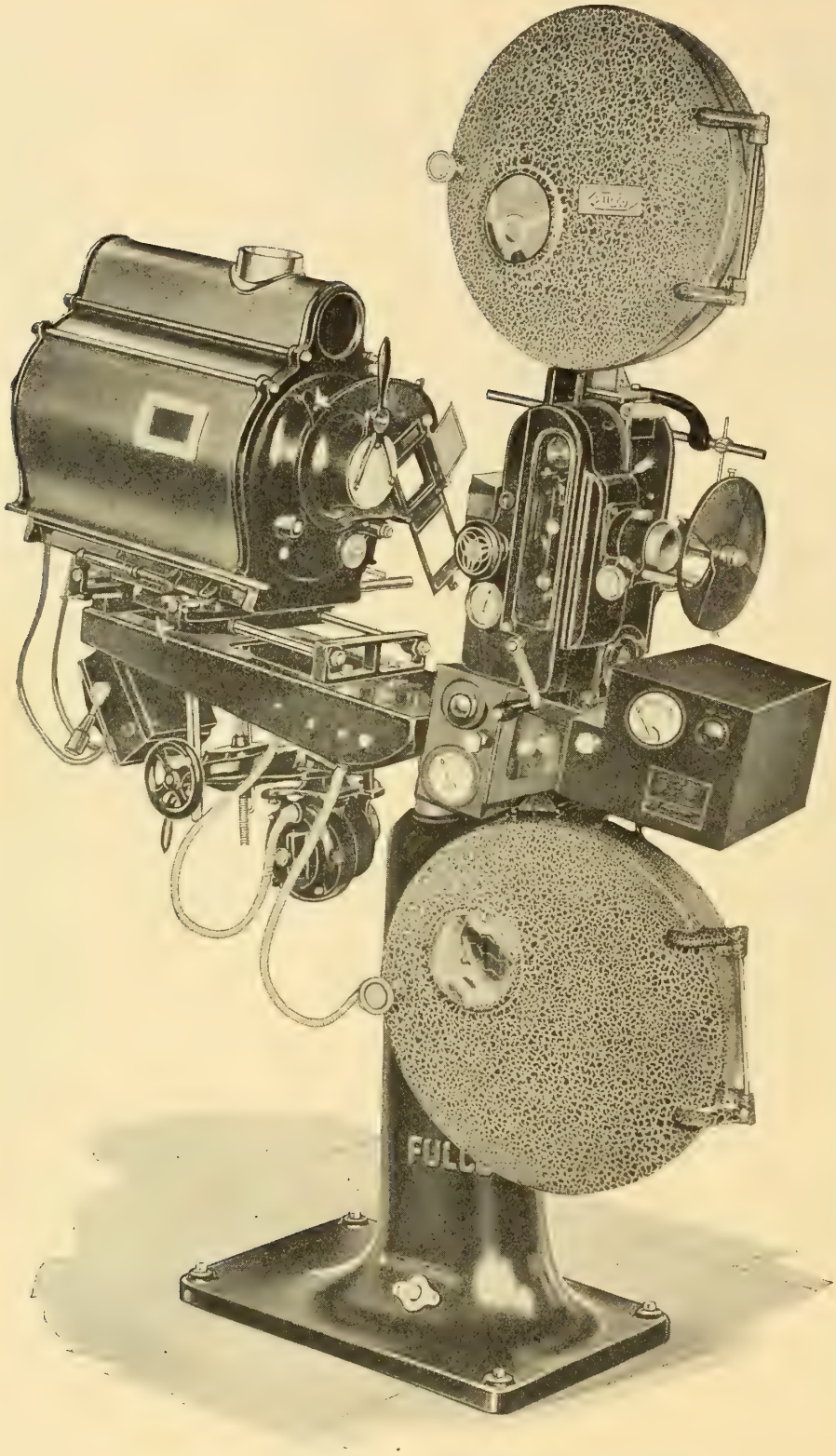
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MOTION PICTURE PROJECTIONIST

August, 1930 Vol. 3, No. 10

JAMES J. FINN, Editor

Frank R. Day, *Personnel;* Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* Arthur Gray, *Conservation;* Rudolph Miehling, *Sound;* John Kieley, *Equipment;* Samuel Wein, *Research;* R. H. McCullough, *Studio Contact;* Harry Rubin, *Improvement.*

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Unique Reproduction Effects for Special Film

CONSIDERABLE deserved publicity has been given to Howard Hughes' three-year-in-the-making special "Hell's Angels"; but of almost equal news value is the splendid results accomplished in the unusual reproduction afforded for the premier run at Grauman's Chinese Theatre, Hollywood. To assure himself of the desired sound effects the producer ran two sound tracks simultaneously with the regular picture film. It was felt necessary in order to get the reproduction of every sound effect of this huge, spectacular air drama. But to accomplish this, since all sound track is on separate films anyway, it was necessary to install a complete special double film inter-locked system in the theatre.

Three dummy projector systems were set up by Electrical Research Products to play the separate sound track. A switching panel permitted the third dummy to connect in parallel with either of the other two.

The result, one never before attempted or accomplished in sound pictures, was that two sound tracks could be played simultaneously and



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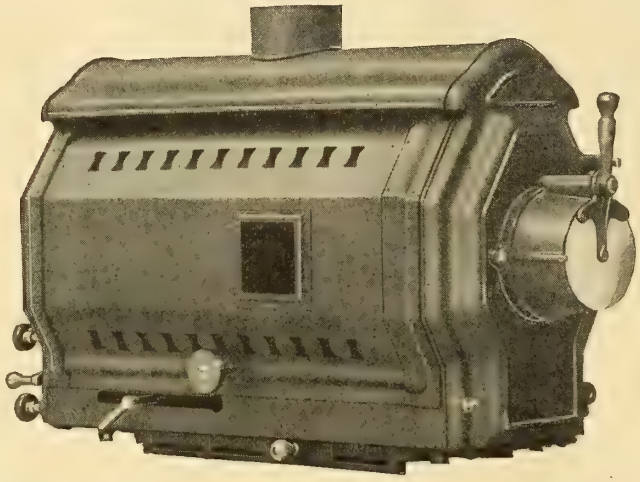
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that the naturalness obtained in the reproduction by playing the two sound tracks at the same time, more than justified the extra trouble and expense.

Six reels of "Magniscope Film" were included in the picture. For these scenes twelve 15-B Horns were installed, use with a 24 foot x 37 foot picture.

Special Amplifier System

To feed this number of horns it was necessary to develop a special amplifier system much more powerful than anything yet used in theatre reproduction. The final outcome was three 42-A Amplifiers, used as bridging amplifiers, to feed into two 43-A Amplifiers. The outputs of these six 43-A Amplifiers fed into nine 15-B horns, making a total of nine amplifiers and nine horns in addition to the regular 1-S three 15-B horn sound picture installation.

An idea of the magnitude of this installation may be obtained from the bank of amplifiers and three Universal Dummy Projectors. A switch provided that for certain scenes this group of amplifiers could be connected with the regular sound installation in such a manner that the sound from the effects system was five times as powerful as the sound from the regular sound system. This was necessary to take care of the tremendous power desired for special scenes, such as the blowing up of an ammunition dump and the airplane sequences.

A. C. or D. C. Resistance?

The phenomenon known as *skin effect*, or the peculiar property of alternating current especially at high frequencies to travel only through the outer portion and not through the core of a conductor, is generally ignored in figuring resistance values for radio purposes. Thus the radio worker is frequently puzzled by the fact that a given solid resistor, rated at a given resistance, actually has considerably higher resistance value in actual use. He may hasten to blame the resistor manufacturer, whereas he has only a well-known electrical phenomenon to blame. A solid conductor offers considerably greater resistance to high-frequency current than to direct current, due to the skin effect.

It is for the above-mentioned reason that the metallized resistor is finding more and more applications in radio work. Such a resistor, having a metallic coating deposited on a glass filament, presents a virtually uniform resistance to either A. C. or D. C. energy. Since there is no core to such a resistance unit, the A. C. or D. C. energy flows through practically the same thin film or skin. Therefore, the resistance value is the same in either case, and there is no chance for error as when using solid resistance units.

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Sound Projection - $6.00
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The papers are full of stories about television. It is estimated by the most conservative authorities that we will have television for theatres within a very short time. Roxy says he wants it at once; B. S. Moss, veteran theatre operator, is building new theatres with provision for television apparatus.

This book, written for the theatre owner, projectionist engineer and technician, gives a valuable outline of the work already accomplished on Television, the scientific and mechanical background, its operation and practical usefulness in connection with motion pictures. It should be read and digested by every member of the theatre staff.

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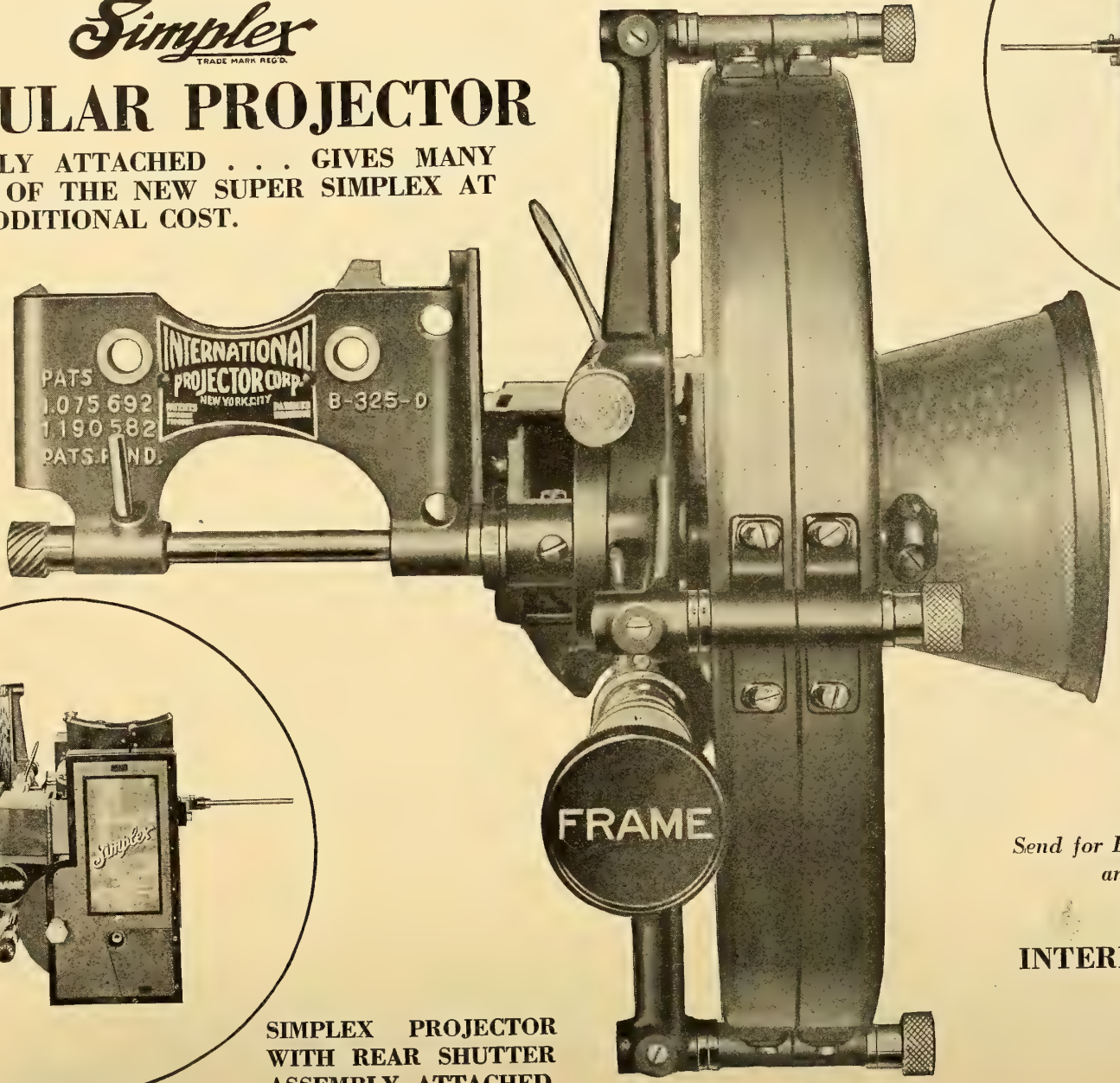
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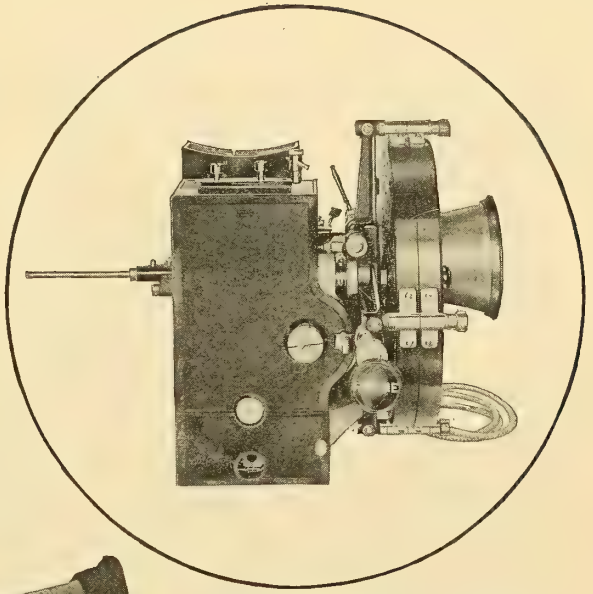
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Acoustical Characteristics of Movie Screens

By H. F. HOPKINS

Member of the Technical Staff, Bell Telephone Laboratories

IN its pioneer stages the sound picture system was used chiefly to provide a synchronized musical accompaniment for the picture. The loud speakers, as a result, were frequently placed in the orchestra pit to give the effect of the presence of an actual orchestra. With improvement in technique, however, the reproduction of dialogue became more general; the accompaniment feature decreased in importance until now a sound picture is usually understood to mean a talking picture—a dramatic screen entertainment reproducing the voice as well as the scene.

To produce the proper effect under these new conditions, a different location for the loud speakers was necessary since the sound should appear to come from the speaker's mouths and thus from the screen itself. Behind the screen seemed the most suitable place. This change brought an added difficulty into the reproduction, however, due to the partial obstruction of the sound by the screen.

To determine how serious the obstruction was, required acoustical tests which the Laboratories was well equipped to make. The frequency response of loud speakers has been the subject of many studies. To make similar tests with a screen in front of the loud speaker, and to compare the resultant sound received to that without the screen in place was, therefore, a comparatively simple matter. This has been done to a large extent as a matter of routine in determining whether certain screens will be satisfactory for sound picture reproduction.

Transmission Three Ways

A screen may be expected to transmit sound in three ways. It may vibrate as a diaphragm driven by the sound from the horn and in turn produce new waves which will be heard by the observers. Also, the original sound may be transmitted through air passages in the screen itself, which is a second method. The third is by wave propagation with the screen material as the conducting medium. Because of the physical properties of the screen, however, the power transmitted by this last method is much smaller than for the other two, so that for practical purposes it may be neglected.

From a knowledge of the tension to which a screen may be stretched and of the density of the material, it might be expected that the natural frequency of the screen as a whole would be low. At this natural frequency the screen would transmit efficiently, but for higher frequencies, where the mass reaction becomes large, the greater portion of the driving force would be consumed in accelerating the screen and little would remain for moving the air load.

This natural frequency, however, is ordinarily below the frequency band used in sound pictures. The transmission efficiency of speech vibrations, therefore, would be highest at the lower frequencies and would decrease as the frequency increases. Furthermore, over the range of frequencies involved, the screen is far from a simple vibratory system. Irregularities occur, therefore, in the sound transmitted although they may be small compared to the total effect.

Punched Holes in Screen

Transmission through air passages in the material proves to be much more satisfactory. Two factors are of primary importance. The aggregate area of the openings in the screen must be adequate to give the proper air load for sound radiation into the theatre, and the dimension of the holes, principally the ratio of diameter to the thickness of the fabric, should be sufficiently large to reduce the mass vibration to a satisfactory value.

The effect of too high a mass reaction is to produce an attenuation that increases with frequency; while an improper air load produces a general decrease in the efficiency of transmission. If these factors are considered in the design, screens may be made which have very satisfactory transmission characteristics.

Before the advent of sound pictures the screens were heavy and not porous. Sound could be transmitted

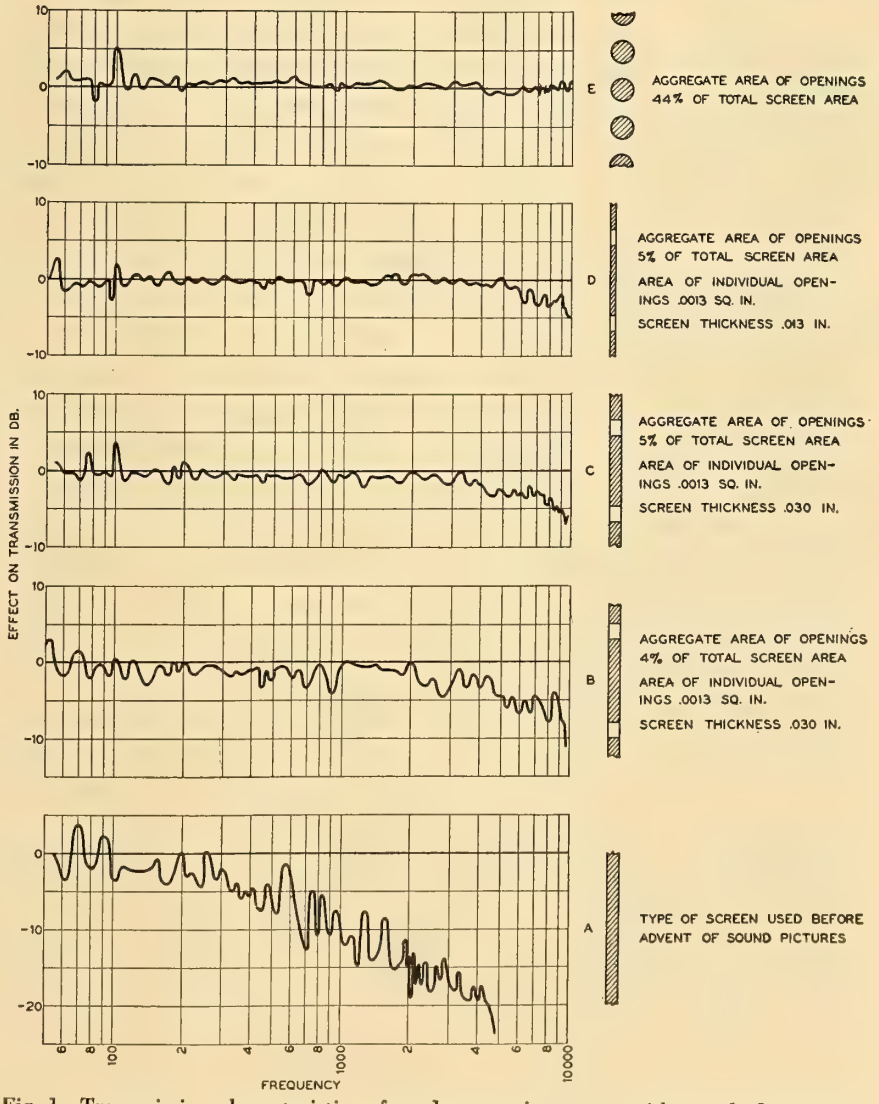
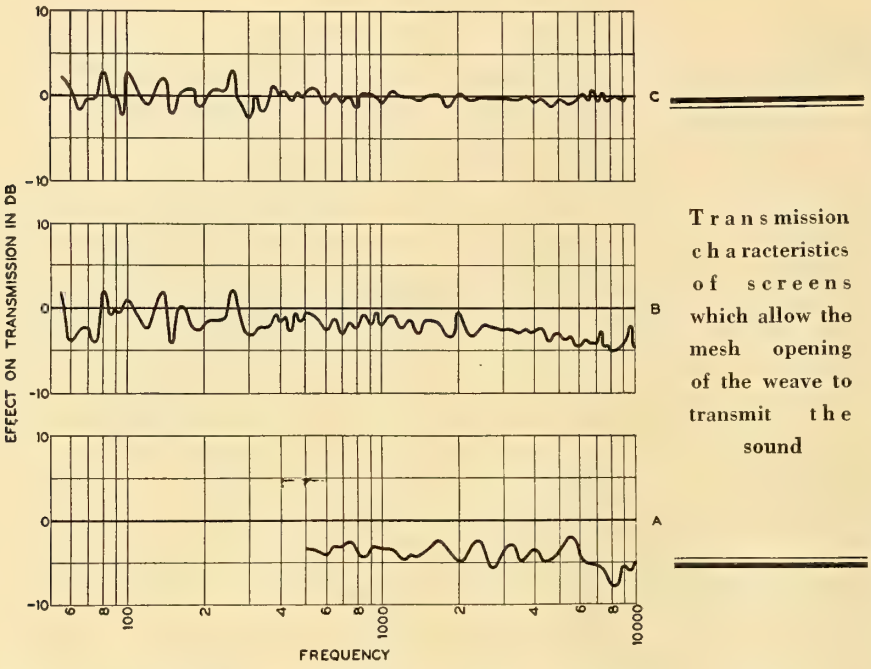


Fig. 1—Transmission characteristics of modern movie screens with punched openings compared to the earlier solid type



Transmission characteristics of screens which allow the mesh opening of the weave to transmit the sound

only by diaphragm action. The result is shown at "A" of Figure 1. There is a rapidly increasing loss with increasing frequency, and the irregularities mentioned above are plainly evident. Since a loss of three *db* means that only about half of the power is transmitted the seriousness of the loss indicated is obvious.

Curve "E" shows the other extreme where the major part of the energy is transmitted through openings in the screen. For this screen the openings constituted about 44 per cent of the screen area, and it will be observed that there is practically no attenuation of the sound, and that the irregularities, except at the very low frequencies where the data are perhaps less reliable, have been considerably reduced.

Smaller Openings Preferable

Although such a screen is entirely satisfactory for the transmission of sound it is lacking in the desirable optical characteristics. Light is not reflected from the openings so that the total light reflected is reduced in direct proportion to the total area of the aperture. The tendency therefore is to provide smaller and more widely spaced openings, as a result of which sound transmission may be partly due to diaphragm action.

Curve "B" shows a characteristic screen of this type. The screen is like that of "A" but punched in it are holes .040 inches in diameter which comprise about 4 per cent of the total area. The screen thickness is .030 inches. The drooping of the curve at the high frequencies due to mass reactance is plainly evident although not nearly so pronounced as in "A." There is also a noticeable loss over the entire range as compared with "E."

Curve "C" shows the effect of increasing the open area by 25 per cent —using holes of the same size but with less separation. Although the dropping off at higher frequencies is still evident, the loss over the entire band is appreciably decreased.

By maintaining the same percentage of open area but reducing the thickness of the screen to about half the former value, and thereby increasing the ratio of diameter to thickness of holes, a further evident gain is made. There is now little or no loss over most of the band and only a very slight falling off at frequencies above 3,000 cycles. The irregularities are also greatly reduced. The acoustical characteristics of such a screen would be considered very satisfactory, and the small percent of open space—about 5 per cent—would not materially reduce the reflection of light.

Openings in the screens discussed so far have been punched in a non-porous screen material, but many of the screens now in use are coarsely woven and meshes of the weave form the only openings for air conduction. As a result the openings are small and irregular in shape, and are apt to be partially filled by fibres from the surrounding threads. Because of this the sound transmission may be seriously affected.

Figure 2 shows the characteristics of three such screens. "C" is a light netting, and while very good as a sound transmitter would be very unsatisfactory both optically and mechanically. "B" represents a rather coarse and heavy material. There is a distinct loss over the entire range as well as a more decided falling off in the higher frequencies. "A" is a still heavier material and considerable loss is evident over the plotted range.

It appears from these investigations that the design of screen is of considerable importance but that it is possible to get screens that are very satisfactory in their acoustical characteristics without appreciable impairment of their optical qualities. The interposition of a screen between the sound source and the audience is no insuperable obstacle to the proper transmission of sound if proper care is taken in selecting the screen to be used.

Common Causes of Trouble

The second of a series of articles prepared from data contained in the files of the maintenance department of a large distributing organization.

THERE is a proper and an improper method of inspecting film. It should be handled between the thumb and first finger, the palm being cupped upward.

Dropping a needle in a pick-up arm on a disc will almost certainly result in chipping.

Half-tone needles, being more flexible than full-tone and not responding so rigidly to high and low intensities, follow the grooves of a record more easily and with less liability of cutting over or repeating.

Discs have been played before two dollar audiences at the Astor, New York, as many as sixty-five times and have then been discarded while giving perfect reproduction. In special tests, disc records have been used up to three hundred runs without impairment of sound quality.

A disc record is likely to play better the second time it is used than it did the first time. This is because the first run has eliminated any little surface inequalities that may exist. The needle, so to speak, has swept out the groove.

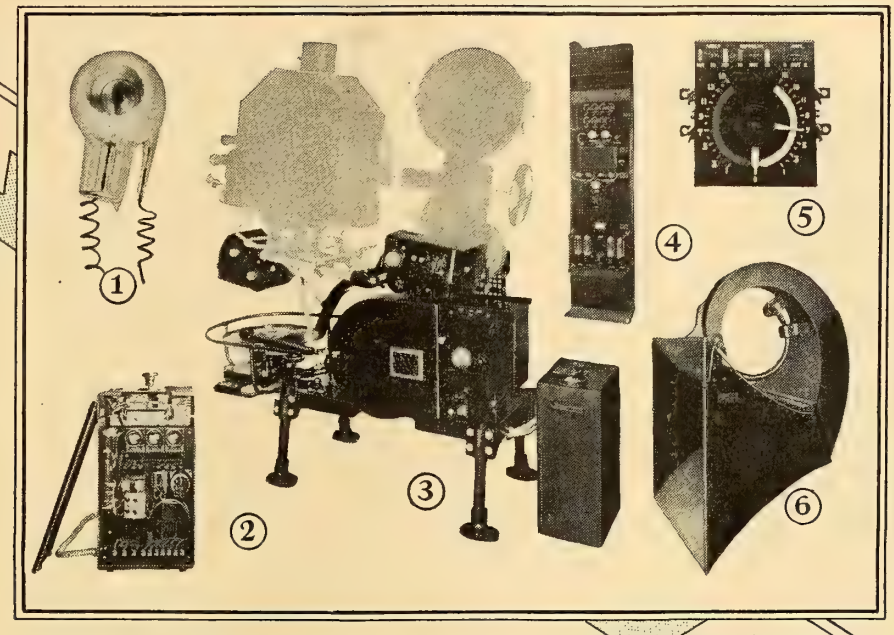
Care of Discs

Unless laid flat when not in use, discs are likely to warp, and unless kept in manila paper envelopes, except when being played, may easily become scratched, dust charged, greasy or otherwise impaired. Discs should always be dusted with a soft cloth before being played.

Lifting the reproducer arm from the disc before the turn-table has ceased to move may easily cause a back lash of the needle which will break down the groove.

Two reproducing machines will not necessarily give the same results at the same fader settings, unless the normal volume from both machines is identical. To determine comparative values, place two identical records from two sets of the same production on the two machines. Set the faders similarly on the two machines. Play part of one record on one machine. Then play the same part of the other record on the other machine. Switch the sound thus from one machine to the other until a thorough test has been made. If one

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Many of the parts which go into the Western Electric Sound System are similar to those used in the nation's telephone system. They are the results of more than fifty years of research and experience in the manufacture of voice transmission apparatus.

The Western Electric Sound System is built to produce the highest standard of quality reproduction demanded by a quality conscious public—and to render that service dependably over a long period. It does not sacrifice quality for price.

Western Electric's undivided responsibility — covering the manufacture, installation and servicing of its Sound System—is your assurance of high quality, trouble-free performance.

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reproducer is lower in volume than the other, it should be serviced immediately. As a rule, low reproduction is also dull in quality.

Every theatre has its own normal fader setting which must first be established by tests before fader cues can be used in a manner truly promoting the illusion of naturalness.

Volume Control

Hearing sound in the theatre day after day sometimes so accustoms theatre attaches to it that the volume seems insufficient. The tendency resulting from this is gradually to increase volume until it is considerably greater than it should be.

The change-over is generally the most ineffectively accomplished part of sound reproduction. Fast action is often slowed down, sound is distorted and continuity is sometimes even broken. Failure to keep the fader of an incoming machine at zero until the machine is up to speed may produce blue notes or unintelligible dialogue.

A break in sound-on-disc film which occurs below the intermittent need not throw a picture out of synchronization. Do not remove the film at the aperture plate nor take the reproducer off the disc. By use of the fly wheel run out enough film for winding around the take up. Then start the machine and when the motor is up to speed bring the fader to normal setting. This should maintain synchronization. Splicing can be done after the reel has been run.

Film Inspection

Sound film splices, if quickly made during projection to avoid a delay in the show, should always be carefully re-inspected before the reel is again run. Very often rough temporary splices are causes of further trouble.

The volume of sound provided in a theatre should not be based on the judgment or inclination of any one person. What is to be sought is that which is pleasing to the ears of the majority. Opinions of persons sitting in various parts of the house often may be advantageously obtained.

The fader setting should be raised as a theatre fills and be lowered as the audience decreases in number. Theatres whose business varies materially on different days will find that a uniform standard of volume for all days is not conducive to the best results.

P. E. Cell Care

A photo-electric cell should be kept in darkness when not in use because light causes it to throw off the electrons which are its active principle.

Sound-on-film prints should never be handled with bare hands. Finger marks on sound tracks materially affect the quality of reproduction.

Splices that are out of frame should never be made in sound film. There must not be more or less than four sprocket holes to a frame and never more or less than sixteen frames to a foot.

Sound film should never be clinched, hammered or loosely wound. The best and most even winding affords the minimum of protection which the sound track requires.

Keep Film Track Clean

Good reproduction is practically impossible unless the film tracks of the aperture plate and tension pad are kept absolutely clean. So little wax, oil or grit in either of these places that it seems infinitesimal to the eye or to the touch, may cause annoying trouble and even results in permanent injury to the film. Both of these areas may be cleansed by using a pipe cleaner and a tooth brush. The film track should never be scraped with a knife because of the danger of scratching.

When running new reels, especially those which never previously have been projected, it is advisable to clean the projection machine aperture plates and tension pads at the end of every reel. Wax tends to accumulate much more rapidly when the print is new than when an old print is run.

Sound reproducing devices are precision equipment. Sprocket wheels which pull the film through the sound pick-up unit, if not made with extreme accuracy, will cause a distortion or reproduced sounds. The eccentricity of the assembled sprocket wheel must be less than three ten-thousandths of an inch, otherwise there will be a flutter in any long sustained note. Many other parts also are very delicate and require microscopic measurement and adjustment in manufacture. All fine machinery requires proper lubrication and intelligent attention.

The Colorcraft Film Process

IN Colorcraft photography duplicate negatives of every scene are necessary. When those panchromatic negatives are brought to the laboratory they are first of all dealt with by continuous printers, capable of turning out over 3,000 ft. per hour. There are fourteen of these printers, which can be worked simultaneously, turning out in all nearly 45,000 ft. per hour. Thereafter these exposed films move through the various processes with clock-work precision. The film is dyed in a mixture of five dyes which can reproduce every color in the spectrum—a distinct advantage over such processes as leaves yellows out of the finished picture.

There are twelve developing units in this plant, turning out film at the rate of over 2,000 ft. per hour, and it is notable that these units are flexible enough in their design to accommodate either standard 35 millimetre film or the new wide film.

Secure Sharp Definition

The quantitative chemical and dye method has been developed in the Colorcraft system, so that the silver image is converted to a dye image, without any loss of definition and without any bleeding or fuzziness. Moreover, the process is entirely automatic, so that all prints come through on a uniform basis. Red, orange, yellow, green, blue and violet can all be faithfully reproduced and Colorcraft can photograph both artificially lighted scenes and natural daylight scenes. The depth of focus is the same as in black and white, and it is notable that the process does not require so much artificial light on the sets as the ordinary black and white film. Some color processes require exceptionally strong lighting; but this is not the case with Colorcraft.

An important feature of the process is the Colorcraft analyser, whose peculiar properties are dependent on radio principles. This analyser employs a photo-electric cell, especially sensitive to the visible parts of the spectrum, as well as the invisible ultra-violet and infra-red. This analyser determines and checks the color values of costumes, drapes and sceneries, and ensures the producer that the finished film will have the same color values as the objects photographed.

Already 3,000 prints can be turned out every 24 hours, of a uniformity that makes each a perfect facsimile of the original. Colors are combined by secret processes and are locked in each film chemically. They cannot be faded, either by long exposure, by contact with machinery or by immersing in water for hours. Colorcraft employs a special hardening process which, by actual test, has been found to result in prints which are four to five times tougher than ordinary black and white stock, and of perfect flexibility.

The process is so carefully planned and controlled that it operates with a minimum of skilled help. There is a control room, in which standard conditions are maintained by a chemist, and a color tester supervises the printing room, where he ensures proper density in the film emulsion.

It is important to note that practically every modern motion picture camera can be converted so that it may be used for the Colorcraft process or for black and white work interchangeably—in five minutes' time and at a cost not exceeding $500.

When Colorcraft pictures are to be taken, it is necessary to use the Colorcraft lens and a special negative stock, costing no more than the present panchromatic negative. The prints are on double coated positive stock, with the sound track printed on one side of this stock when required.

Revolving Lens Wheel Projector

By ARTHUR J. HOLMAN

An outstanding feature of the recent S. M. P. E. meeting at Washington was the demonstration of and lecture on a continuous optical projector by Mr. A. J. Holman, its inventor. The substance of Mr. Holman's paper is presented here, together with illustrations for which we are indebted to him. Mr. Holman has kindly offered to answer any and all questions concerning this projector in subsequent issues of this publication, so send along your inquiries.—THE EDITOR.

THE desire to reproduce motion in pictures, for the purpose of study and analysis, is the origin of the great motion picture industry. The stroboscope, as you know, was one of the early and rather crude instruments developed for motion study, and, strange as it may seem, its basic principles are still employed universally wherever motion pictures are shown. I refer particularly to the picking out of portions of a complete action by the shutter mechanism of the motion picture camera, and the presentation, through the medium of an intermittent mechanism, of these same portions of action on the screen of the theatre. Such a recording and reproducing system, involving intermittent film movement, must necessarily fall far short of the ideal for the following reasons:

First, the screen illumination is entirely unnatural in that it pulsates rapidly from zero to maximum value.

Second, the maximum light intensity on the screen must be excessive to secure the desired average brightness because of the shutter cut-off.

Third, rapid actions have a jerky appearance, for even persistence of vision, that physiological and fundamental foundation of present-day movies, cannot fill in the action obliterated by the camera shutter.

To eliminate the stroboscopic principles from motion picture presentations and to remove, or at least mitigate, the evils of intermittent illumination, have been the goal and aim of inventors and experimenters for many years, and more ideas have been conceived to this end than most of us are aware of. As is usually the case, however, the most fantastic and utterly impossible optical systems and mechanisms have been promulgated by both novices and those skilled in the art, and the simplest and most logical means has been meticulously avoided, the only apparent reason being that the simple system is considered utterly impossible by those well grounded in optical theory. But the "impossible" is often the most fruitful ground for research and invention, and the more certain authorities are that "it can't be done," the more likely are the prospects for discovery. . . .

Continuous Motion

In the language of the Patent Office, this invention relates to that type of projecting apparatus, or camera, wherein the film strip is kept continuously in motion and the effect of said motion is so compensated by means of moving optical rectifying elements as to produce a well-defined image. A complete mental picture of our ideal projector may be gained from the following:

Let us suppose that we have an aperture across which a film strip may be actuated, a light source, and condenser system which will illuminate uniformly the area of this aperture, and an objective system which will distribute light passing through the aperture in such a manner as to produce a uniform illumination over the entire area of a screen. Now suppose that a film strip is moved across the aperture at a uniform linear velocity, and the objective system is so constituted that

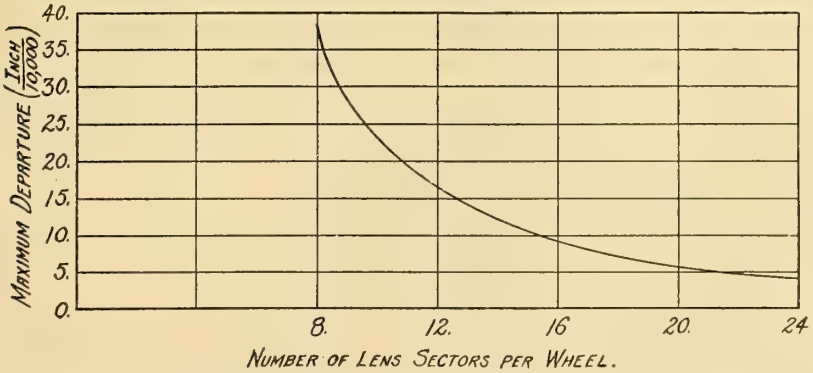


Fig. 1—Curve showing the relation between the number of lens sectors per wheel and the maximum departure of the equivalent center of the objective system from its theoretically correct position

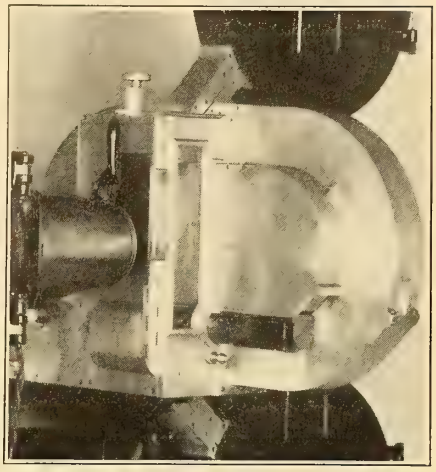


Fig. 2—Rear right side view of mechanism

it will form on the screen a stationary image of each film frame, and will accomplish the transition from frame to frame, as the film advances, through the medium of a dissolving action, without varying the light intensity or interfering with the definition of the resultant screen image.

In other words, we wish to provide an optical system capable of producing uniform maximum illumination over the entire surface of a screen, and having the capacity to modify the intensity locally in proportion to the density of the corresponding part of the film frames which are passing constantly over the aperture plate. Measured against such an ideal, the present system of intermittent projection shows up as a poor makeshift.

Long List of Failures

Much thought has been devoted to solving the problems arising as men have sought to eliminate the intermittent movement and approach more closely to the recognized ideal. Many, many systems have been thought out and tried, and a few very ingenious devices have been constructed, but they have all fallen by the wayside due to inherent mechanical or optical difficulties which make them impractical.

Reflecting systems have been used almost exclusively by searchers after the ideal, and one or two of these have been developed to a high state of perfection, but they fail in service because they involve complicated mechanical movements which require cams for their accomplishment; moreover, reflecting surfaces of great optical accuracy are not easy to manufacture or maintain at high efficiency in service. Although spectacle makers have long recognized and used the prismatic power of decentered thin

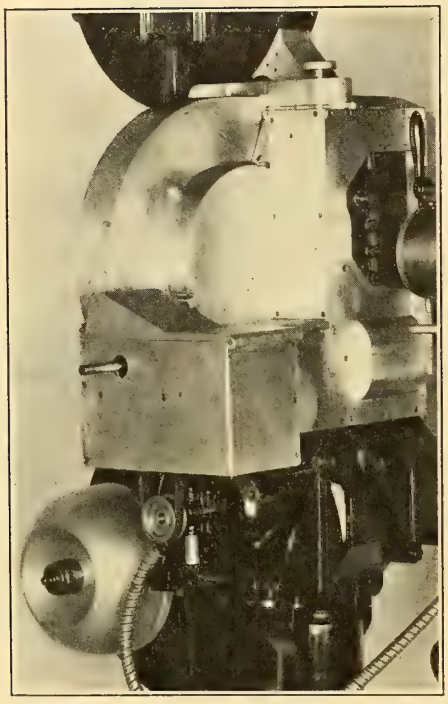


Fig. 3—Rear-left side view of mechanism

lenses, it has occurred to very few that this principle might offer the easiest approach to the perfect system of recording and reproducing motion in pictures.

The continuous projector we have developed, and which I will now proceed to describe, functions entirely and solely because of this inherent characteristic of a thin lens which produces a prismatic or bending action proportional to the decentration. It was discovered nearly thirty years ago that an optical system comprising a stationary lens element and a pair of overlapping revolving lens wheels would produce on a screen a stationary image of pictures on a film strip provided the film strip was continuously moved across the optical axis at a rate properly proportioned to the angular velocity of the revolving lens wheels. Unfortunately, the original inventor, lacking one or more of the three essentials, ability, financial means, or stick-to-it-iveness, not only never solved the problem himself, but left a monument in the Patent Records which has been effective in causing investigators to shun the basic idea long after the expiration of his patent.

Our projector embodies the results of a mathematical analysis of the revolving lens wheel system and includes many new and original mechanical and optical features which are essential to the practical application of this system.

Objective Lens System

As stated previously, our ideal projector consists essentially of a suitable light source, a condenser system, and an objective system, the latter comprising spherical lenses only. The objective system is composed of a stationary front element, comparable to the front element of an ordinary projection lens, and pairs of rear elements which constitute the peripheries of the two revolving lens wheels, these pairs of rear elements replacing the rear element of an ordinary projection lens. The first important feature to be noted is that our objective interposes the same amount of glass between the aperture plate and the screen as does the ordinary projection lens, therefore, its light-transmitting efficiency, with equal lens apertures, should be about the same. Moreover, since the axial spacing and refractive powers of the elements are comparable to those of an ordinary projection lens, there is nothing freakish in the system requiring special optical treatment. . . .

The perfect system would consist of a stationary front element and a continuous procession of identical rear elements, all equally spaced and moving downward at a constant linear velocity over a straight path at right angles to the axis of the stationary element. But such an optical rectifying system lies in the realms beyond the range of our mechanical ability; therefore, we must substitute for the perfect, some mechanical arrangement which is practical and which may be so designed as to approach as closely to perfection as we may desire. Since rotation at uniform angular velocity is a movement well within our mechanical ability to produce, and since this movement alone is sufficient for our requirements, we have chosen, in the present machine, to use a pair of overlapping revolving lens wheels. Two lens wheels are used to secure the balancing effect of one wheel upon the other, which eliminates all lateral variations and thus permits a very close approach to the theoretically perfect, with wheels of relatively small diameter.

. . . In order that the objective system may function properly, it is necessary to provide a condenser system which will illuminate the entire aperture uniformly, and will produce a beam having a circular cross-section of small diameter at the plane midway between coacting lens sectors. In the interest of economy, it is also essential that the cross-section of the condenser beam, in the plane of the gate, be of such shape and proportions that the maximum amount of light may be transmitted through the elongated aperture.

Employs Cylindrical Elements

To accomplish these ends, I have long been using a cylindrical surface in the main condenser and a complementary sphero-cylindrical gate lens which is mounted in close proximity to the film strip. The first mentioned cylindrical element provides a vertically elongated spot at the gate, having the form of an ellipse and fitting closely to the contour of the elongated aperture. The sphero-cylindrical gate lens remolds the condenser beam so that it becomes circular in cross-section as it enters the objective system.

The projector is now equipped with a low intensity reflector lamp having a standard reflector and a condenser which was standard before I reground and polished the flat surface to cylindrical form.

Having designed an objective system approaching the ideal in accuracy, and having provided a condenser system fulfilling all the requirements, the mechanical problems involved in operating the lens wheels and film strip in proper relation, remain to be solved. As a first con-

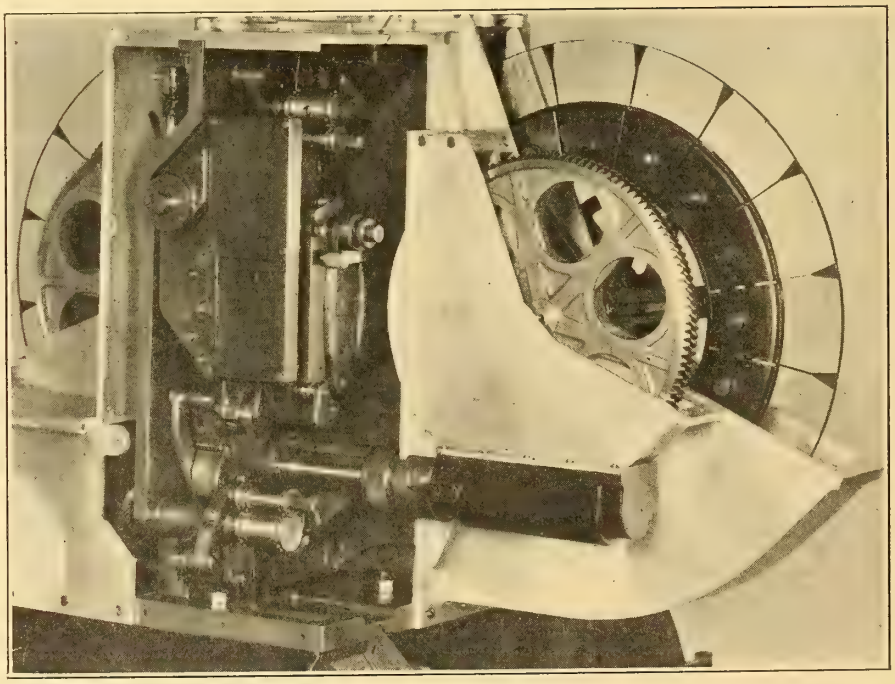


Fig. 4—Rear-right side view of mechanism with door and cover plate removed

sideration, the mechanism must be easily adjustable to meet the requirements of the optical system in regard to film shrinkage, and a framing adjustment must be provided. Moreover, the lens wheels must operate in exact synchronism and the film strip must be actuated across the aperture plate at a uniform velocity exactly proportional to the angular velocity of the lens wheels. The steadiness, definition, and pleasing qualities of the projected image depend almost entirely on the accuracy with which these functions are performed.

Unsteadiness Eliminated

Unsteadiness in the projected image has been my most serious problem in connection with this work, and since it has been eliminated by the installation of precise gears, it is not difficult to show that the trouble has been mechanical rather than optical. A better understanding of the nature and cause of unsteadiness in the projected image may be had from the following analogy:

Let us think for the moment of the screen image as being supported in a state of equilibrium by three elastic ribbons, one being attached at each of the top corners and the third being attached at the middle of the bottom edge. We must think of the image as being rigid but having no weight, and moving as a whole if any change occurs in the tension of the supporting elastic ribbons. The tension of each of the top elastic ribbons, in our analogy, is to be likened to the angular velocity of one of the lens wheels, and the tension in the bottom elastic ribbon compares with the velocity of the film strip across the aperture plate.

Any change in the tension of one or more of our imaginary elastic ribbons, unless accompanied by a proportional simultaneous change in all three, will cause a displacement of our imaginary rigid image. In like manner, our real projected image is in suspension, and any change in the angular velocity of a lens wheel, or in the linear velocity of the film strip, unless accompanied by a proportional simultaneous change in velocity in all three elements, will produce a displacement of our real projected image.

. . . Since no means other than gears are available by which the lens wheels and film strip may be actuated, it is evident that the more simple the gear train the less difficult will be the commercial production of the mechanisms. The present model, designed in 1926, can be considerably simplified in this respect, and some idea of the improvement may be gained from the following comparison:

This model has two worms and two worm-wheels between the lens wheel shafts; the new model will have but two gears between these shafts, therefore the probability of errors in synchronization of the lens wheels, with gears of equal accuracy, is one-half. This model has seven gears between each lens wheel shaft and the aperture film sprocket; the new design, providing the same flexibility for framing and adjustment of the optical system, requires but two gears between the aperture sprocket and a lens wheel shaft. It is evident, therefore, that the new gear train, with gears having an accuracy of the order of those in this machine, will have at least a five-to-one advantage over the present arrangement, in the matter of steadiness. Moreover, the new gear train is far less expensive to manufacture.

Lens Manufacturing Process

I have purposely avoided any reference to the accuracy required in the construction of the lens wheels. It will be sufficient for the present to state that the manufacture of lens wheels, by the usual methods of lens manufacture, would be difficult, costly, and generally unsatisfactory. To meet the new requirement for quantity production of first quality and exactly matched lenses, an entirely new method of grinding and polishing has been developed. A special optical instrument has also been devised for exactly positioning the lens sectors on the lens wheels. With this new equipment it is not difficult to obtain the desired accuracy in the lens wheels and they can be produced commercially at a surprisingly low cost.

Thus far I have described only the essential features of the revolving lens wheel projector. The fact that the film strip moves across the aperture at a uniform rate has many advantages, and one of these is the ability to actuate a sprocket, located just above the aperture, by the movement of the film strip. This film-actuated sprocket operates an automatic fire-shutter control mechanism. With the fire shutter thus controlled by the movement of the film strip across the aperture plate, its response is sure and instantaneous in case of film breakage at the aperture, or slowing down of projection below the predetermined minimum rate.

The projectionist has no control over the action of this fire shutter nor does he need it, since the shutter cannot close unless there is imminent danger of igniting the film. Another advantage of a continuously moving film strip is that the tension shoes can function perfectly with very little pressure, because there is no effect equivalent to the "over shooting," which produces unsteadiness in intermittent projection unless the spring tension is considerable. Since there is no periodic "breaking from rest" under heavy tension, there is very little strain on the film strip in continuous projection, and "green" prints, direct from laboratory processing, may be run without waxing or other lubrication. In fact, prints may be projected hundreds of times without showing any appreciable wear and without accumulating scratches and dirt over the photographic areas. This is an important advantage, especially in the projection of sound-on-film prints.

Improved Take-up

Having removed from the projector mechanism the principal causes and sources of wear and damage to the film strip, effort was next directed toward improving the film take-up device with a view to eliminating damage to film from this source. It is pretty generally known that much damage may be done to film during the rewinding operation, and the reason is apparent from an examination of the wound film when the take-

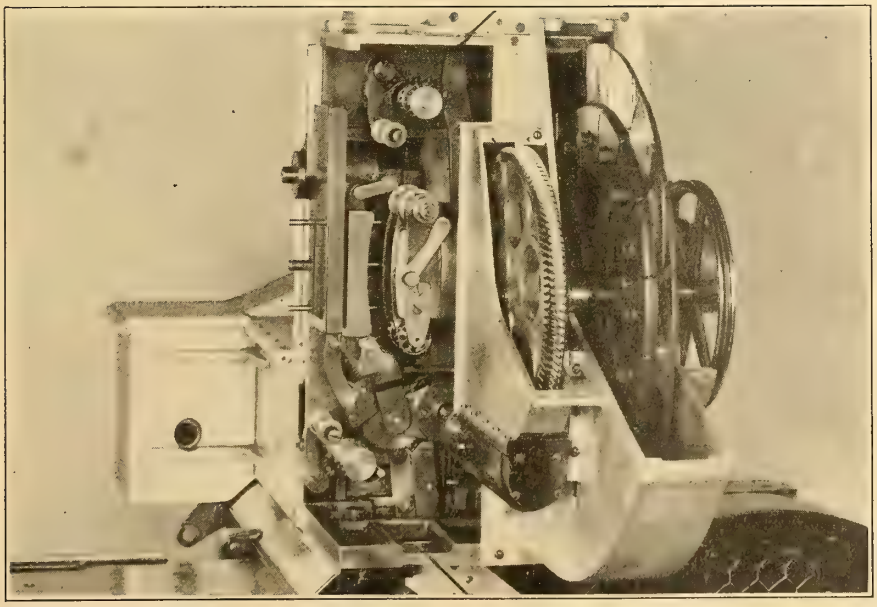


Fig. 5—Right side view of mechanism with door and cover plates removed, showing gate open for threading

up reel is removed from the lower magazine.

The ordinary take-up drive is a constant torque affair and is adjusted so that the initial winding on the take-up reel will not be sufficiently tight to cause damage to the film perforations on the lower or "hold-back" sprocket. With this adjustment of the driving torque, the tension on the film strip, during the initial take-up when the wound diameter is small, will be considerably more than is necessary to produce a solidly wound mass, but, as the diameter of the wound mass increases, the film tension decreases, and, generally speaking, the outer layers of film, to a depth of one to three inches depending on the torque adjustment, are wound rather loosely.

When the reel containing the film, which has been wound at a progressively decreasing tension, is put on the rewinder and the end of the film is attached to the empty reel and the the motor is started with a jerk, it is not difficult to understand that film will be drawn from the reel before the reel begins to rotate, and there will be a progressively decreasing amount of slippage between film layers, from the outer layer down to that inner layer which has been wound at a sufficient tension to balance the pull of the power-driven reel on the rewinder.

If the brake on the reel being rewound has not been released, the conditions will be aggravated and the slippage between film layers will go deeper into the reel. The film, in passing through a projector, collects dust, dirt, bits of emulsion, and other grit, which adhere to its surfaces, and when, in the rewinding operation, these surfaces slip over each other under pressure, the conditions are ideal for the most effective abrading. The film damage which shows up as "rain" and is most prevalent toward the end of a reel, is generally caused in this manner.

It is interesting to observe that the advent of sound-film prints has drawn more attention to the take-up conditions, and the improvement thus far made has taken the form of new type reels with larger diameter hubs and of more sturdy construction. These new reels, incidentally, cost several times as much as the better grade reels of a few years ago.

Our projector is equipped with a take-up control which may be adjusted to give a practically constant winding tension on the film for all diameters of the wound mass, and it will operate equally well with an old-fashioned reel having a two-inch diameter hub, or with one of the new type reels. This take-up control is a variable torque device, the pressure between the friction drive members being varied by centrifugal force through the medium of a system of balanced springs.

At the higher reel speeds, during the initial take-up when the wound mass is of small diameter, centrifugal force acts to reduce the driving torque, thus preventing excessive film tension. As the reel speed decreases, centrifugal force is reduced and the balanced spring system acts to increase the pressure between the friction drive members, thereby increasing the driving torque and maintaining full tension on the film. Adjustments are provided by means of which the film tension may be regulated for three stages of the take-up operation, namely, empty reel, half-full reel, and full reel. With this device the film is wound on the take-up reel under practically constant tension; therefore it acts as a solid mass and is not subject to damage during the rewinding operation.

Masking of Images

Continuous projectors which accomplish the transition from frame to frame through the medium of a dissolving action without the interposition of a shutter effect, must be provided with an aperture which is at least two film frames in height; therefore some means must be associated with the projector to prevent the appearance of images above and below the one centered on the screen. It has been common practice to use a mask, placed several feet ahead of the projector, for this purpose, but such a device, while effective, is nevertheless wasteful as it absorbs images which may be redirected to the screen.

Our projector, when used with the customary mask, is equal in light-transmitting efficiency to the best intermittent projector equipped with the best large aperture projection lens. This has been proven to the entire satisfaction of representatives of projector manufacturers in recent tests. When our projector is used in association with an optical economizer having the capacity to redirect the extra images to the surface of the screen in such a manner that they may register with each other and with the image already on the screen, the light-transmitting efficiency is more than doubled.

In this connection another very interesting development is made possible. In the revolving lens wheel projector, which provides a dissolving action occupying a large portion of the picture cycle, the aperture is about three frames high; therefore, with the aid of an optical economizer, it is perfectly possible to produce on the screen a continuous dissolving action involving three separate film frames at all times. This represents the ideal condition for a three-color system of natural color projection according to the additive method. The individual film frames are not required to carry the full color values, as the natural colors are produced on the surface of the screen by the mixing of the three primary color values supplied by three successive film frames.

Natural Color Projection

According to this method of natural color projection, the prints are made in black and white, in the usual manner, from a negative exposed in a color camera equipped with a three-color filter wheel. Filters are necessary to bring out the colors in projection, but these will be applied direct to the positive print in the form of red, yellow, and blue tints over successive film frames, the red tint being applied over those frames printed from the negative frames originally exposed through a red filter, etc. This system of natural color projection will be relatively inexpensive and will have the same resolving power as black and white prints.

Although the basic idea is that of

(*Continued on page* 37)

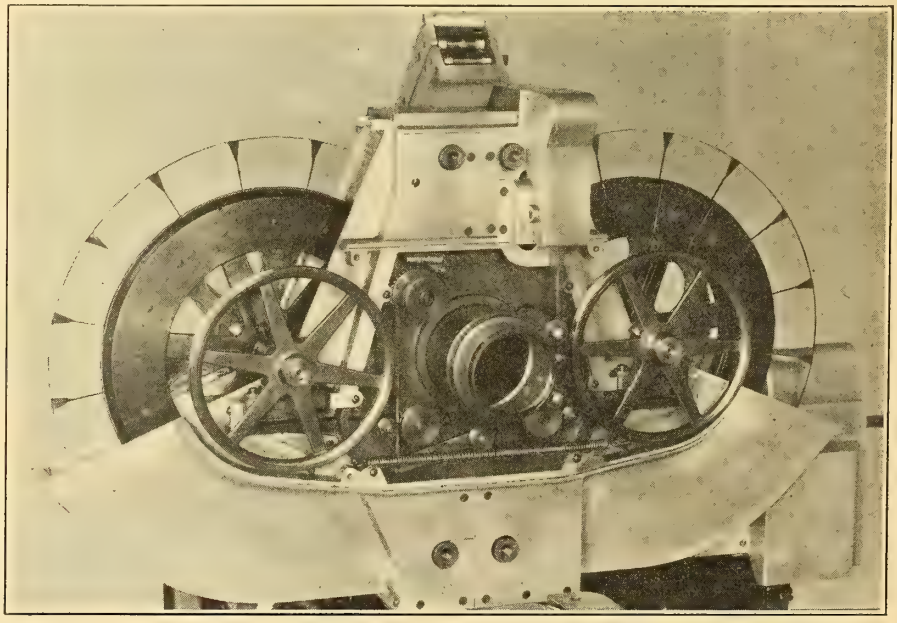


Fig. 6—Front view of mechanism with cover plates removed, showing lens wheels, brake wheels, balanced drag mechanism, and mount for front element of objective

Sound Equipment Inspection Routine

In the belief that a comprehensive inspection routine properly prepared and rigidly adhered to by the projectionist would render unnecessary more than sixty per cent of the present service calls on sound motion picture equipment, the following chart has been prepared by Victor Welman for the members of Cleveland Chapter, American Projection Society. Splendid results have been obtained with this routine and its general circulation among projectionists is desirable.—The Editor.

A STUDY of the service calls that have come into the local Service Department on sound equipment shows some unexpected results. Equipments which are regularly inspected by the projectionist for the purpose of service engineers' reports to the manufacturers rarely call for special service for anything other than breakdowns in equipment that could have been foreseen and forestalled.

On equipments where this regular inspection is not made necessary by the manufacturer, fully two thirds of the calls for assistance are for troubles that a careful inspection would have disclosed before they had reached the point where the show was stopped or quality impaired.

This can mean but one thing—every installation of sound equipment must be inspected regularly and systematically by those in charge of it. Such an inspection can only be successful if it follows a definite routine. If a regular chart is followed it finally becomes second nature to watch for the things indicated, but if no regular routine is followed then many things are missed until something happens. All the technical information in the world is not going to help put the show on if the equipment is not kept in condition.

Inspection Chart

A chart is given below suggesting a routine which, if followed in inspection, would eliminate much trouble. There is scarcely an item in this entire chart which cannot be pointed out as the basis of a trouble call in some of our houses.

Pick-Up:

Film,
- Coupling resistors.
- Filament and exciting lamp rheostats.
- Exciting lamp (focus, filament, blackness).
- Slit assembly (oil, focus, alignment).
- P. E. C. (position, lead).
- Amplifier suspension cradle free.
- Oil in amplifier or cable.
- Switch clicks.
- Film batteries and fuses.

Disc,
- Drift in reproducer.
- Reproducer, (noisy, low volume, needle holders).

Fader,
- Clean.
- Operates normally.

Switching Panels,
- Contacts (clean, function properly).
- Relays.
- Signal lamps.

Amplifier:

Gain Control (clean).
Transformers (heating).
Filter condensers (clean—normal appearance).
Snap switches, keys, packs.
Sockets (contacts clean, tight).
"C" batteries, (voltage, age).

Union Men Best, Says School Head

At a recent convention of public school principals held in San Francisco, Calif., Miss Mary Mooney, head of the Department of Visual Instruction, San Francisco Public Schools, stated that in her opinion and as a result of her extensive experience in visual education in public schools, the employment of Union projectionists was the best insurance of efficient and safe projection.

Miss Mooney, who is responsible for the safety of thousands of children at shows given by her department, said: "The equipment in the projection rooms of the larger school auditoriums and the projection of all moving picture film of the inflammable type is under the control of a professional projectionist who has the qualifications which meet the standards of both the local fire department and the local projectionists' Union. This individual exercises general supervision over the installation and servicing of all projection equipment and accessories used in the schools.

"My experience has demonstrated conclusively that the retention of a projectionist who is responsible to his Local Union for efficient work and for careful and safe work is the best insurance of a good show and a safe show."

William G. Woods, Secretary of L. U. 162 in San Francisco, heads the projection staff of Miss Mooney's department.

Meter readings.
Fuses.
Tubes, (matched, contacts clean).
Socket mountings.

Power Supply:

Batteries,
- Electrolyte level.
- Specific gravity.
- Clean.
- Connections (tight, greased, clean).
- Battery log.

Charging Panel and Charger,
- Fusing.
- Switches.
- Charging rate.
- Functions normally.
- Connections tight.

Motor Generator and Converter,
- Brushes and commutator.
- Overheating and vibration.
- Lubrication.

Mechanical:

Lubricants and lubricating interval.
Chain tension.
Motor flywheel (tight alignment).
Motors, (alignment, vibration).
Drives and gear boxes (heating, grinds, alignment).
Rubber connectors.
Set screws.
Couplings.
Film Sprockets.
Stripper plates.
Tension shoes.
Guide rollers, (condition, adjustment).
Turntable level.

Wiring:

Connections (soldering, tight).
General condition.
Ground connection (clean, greased).
Conduit (well fastened).

Motors:

Commutators.
Brushes, (clean, seating properly).
Speed—acceleration.
Fuses.

Spare Parts:

List of parts needed.
See that these parts are on hand.

A uniform and complete routine followed out every day in starting the equipment and preparing to start the show will head off many of our troubles. Here is a suggestion as to a routine which only takes a few minutes yet is fairly complete.

Suggested Starting Routine:

1. Batteries checked.
2. Apparatus cleaned.
3. Exciting lamps checked, (focus and condition).
4. Oiling and greasing.
5. Testing system and horns.
6. Testing motors and mechanisms.

As The EDITOR *Sees* IT

¶ *Proper Working Conditions*

WITH September rapidly approaching attention within the craft is being focused upon impending wage scale negotiations in which wages will be set and working conditions agreed upon. In wage scales we have merely an academic interest, for this is purely a local problem the solution of which may safely be left to Local Unions and local theatres. But working conditions is a question in which we are very much interested for the reason that it is a problem which vitally affects the entire industry.

Preparations for the September negotiations are already being made, particularly in the Northwest where the exhibitors' organization has announced that a reduction in the number of men from two to one on a shift must precede any wage scale discussions. We find it hard to believe that these exhibitors are serious about this proposal, for it is manifestly impossible for one man to put on an acceptable sound picture show. Undoubtedly the proposal was put forward merely as a check on any increased wage scale, and the plan will serve ideally as a trading point. However, forearmed is he who is forewarned, and no labor organization should countenance even temporarily such a reduction in manpower.

We are wholly confident that September will come and go without any untoward disturbance on wage scales, but we cannot refrain from expressing the hope that any proposal for a one-man sound picture shift will be promptly vetoed by the negotiators.

¶ *Revolving Lens Wheel Projector*

AT the recent S.M.P.E. meeting in Washington there was demonstrated an optical projector the performance of which occasioned much favorable comment. From the accompanying lecture one may have gleaned the information that this projector embodied certain features which successfully overcome the more common objections to mechanisms of this type. This optical projector, the work of Mr. Arthur Holman, appealed to us very much, and we were pleasantly surprised to discover that for amount and quality of illumination, steadiness and definition it compared favorably with the best intermittent projectors. On only a few points were we a bit doubtful, and these the matter of accuracy in matching the condensers used on the revolving lens wheel, the stability of the mechanism, and the amount of care necessary to prevent breakdown.

All of these points are treated in the article by Mr. Holman, "Revolving Lens Wheel Projector," which appears elsewhere in this issue. Mr. Holman's development, work on which has occupied him for more than fifteen years, is of particular interest in view of the oft-repeated assertion that no really serious work is being done in the field of motion picture mechanics. Here, surely, is a signal contribution to the art, and, whether it finally wins general approval or not, this work is significant as an index to the advanced school of thought the influence of which is becoming more pronounced each year within the industry.

¶ *East Is East and . . . .*

A LEADING exhibition organization recently switched their house managers about, some men even being changed from Coast to Coast. We inquisitively approached a recent arrival from the West Coast and asked him how projection in the East compared with that on the West Coast. His answer was indicative of the astonishingly lax conditions existent in many Eastern houses. A few excerpts from his remarks follow:—

"When I first came East I was inclined to blame the projectionist for some rather obvious defects in the shows presented, but this feeling gave way to one of sympathy upon my first visit to my theatre's projection room. In a house considered to be not far removed from what you Easterners call the 'de luxe' class I found a projection room that for layout, equipment, and conveniences for the projectionist would be classed as a 'dump' on the Coast. The entire projection room equipment in the house, with the exception of the sound apparatus, could be junked without losing anything of value."

And this from the manager of what is considered a first-class house, a unit of a major exhibiting organization!

¶ *Attachments for Wide Film?*

DESPERATE efforts are being made by motion picture producers to obviate the necessity for the installation of new equipment in order to obtain a wider picture on the screen. In other words, while the wide film is desirable from every angle, the prohibitive costs of this change in standards is causing film company executives no little concern. Numerous comments were received as a result of our remarks in the editorial "The Industry's Wide Film Bill," in the last issue.

We cannot agree with those who do not anticipate wide film for more than a year yet. We feel certain that by this time next year there will be a scramble on the part of theatres for wide film, our only doubt at present being concerned with the form to be assumed by the reproducing equipment. Will attachments suffice for wide film; or shall we see another orgy of spending for entirely new equipment? We must confess our inability to answer this question just now.

However, information which we have received just prior to the time these lines were written leads us to believe that some means will be found to adapt the present equipment for the showing of wide film. Many of us recall Captain Fear's article, "Wide Image on Standard Film" which appeared in these pages some months ago. This Fear process involved "shooting" and projecting the picture image horizontally on the film, requiring comparatively minor changes in all equipments. A proportionate increase of the present image would result in altogether too much height, and some means for securing width without height should and probably will be found.

Two-Way Television

By HERBERT E. IVES

Electro-Optical Research Director, Bell Telephone Laboratories

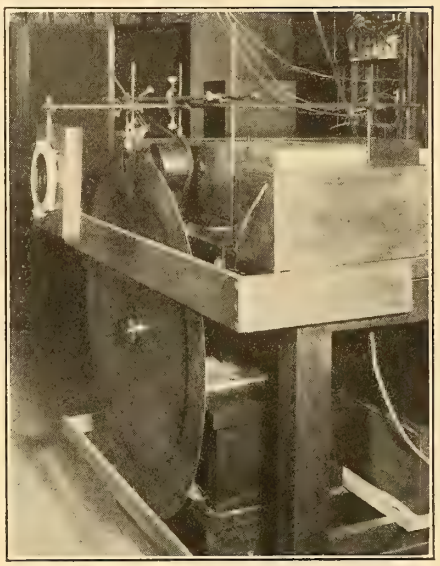
EVER since the initial demonstration of television both by wire and by radio at Bell Telephone Laboratories in 1927, experimental work has been steadily pursued in order to learn the problems and the possibilities of this newest branch of electrical communication. The latest development to be demonstrated is that of two-way television. As a result of our development work, there is now set up an experimental and demonstration system between the headquarters building of the American Telephone and Telegraph Company at 195 Broadway and the building of the Bell Telephone Laboratories at 463 West Street, New York City, two miles away. This system makes it possible to experiment with a method of communication in which the parties engaged not only speak with each other but at the same time see each other. Study of this system will serve to give information on the importance of the addition of sight to sound in communication and will give valuable experience in handling the technical problems involved.

In principle the two-way television system consists of two complete systems of the same sort as those used for one-way transmission in the demonstration from Washington to New York City in 1927. In place of a scanning disc and set of photo-electric cells at one end for generating the television signals and a single disc and neon lamp at the receiving end for viewing the image, there are in the two-way system, two discs at each end and a bank of photo-electric cells and a neon lamp at each end. One of the discs, which in the system as constructed, is of 21-inch diameter, serves to direct the scanning beam from an arc lamp onto the face of one of the parties to the conversation. Three banks of photo-electric cells, making 12 in all, are arranged at either side and above the person's face and serve to pick up the reflected light and generate the television signals. The second disc, which is 30 inches in diameter, is placed below the sending disc and exposes through its holes the neon lamp, which the observer sees through a magnifying lens in a position slightly below that of the scanning beam. This neon lamp, is, of course, actuated by the signals coming in from the distant end of the system, where there is a similar arrangement of two discs, photo-electric cells, and neon lamp.

The two parties to the conversation take their places in sound-proof and light-proof booths where, sitting in front of the photo-electric cells, they look at the image of the person at the other end at the same time that the scanning beam plays over their faces. A problem of illumination is immediately encountered in that the scanning beam is of necessity intensely bright and tends to dazzle the eyes to the extent that the somewhat faint neon lamp image is hard to see.

72-Hole Discs

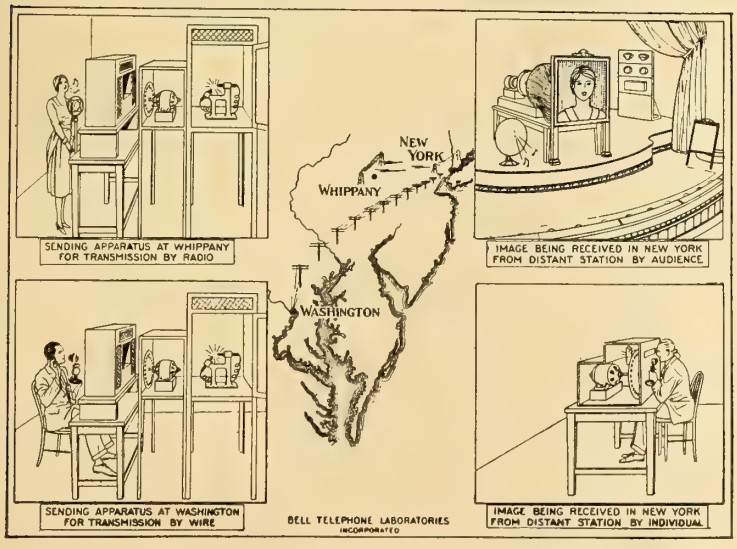
This difficulty is met by using light for scanning to which the photo-electric cells are extremely sensitive, but to which the human eye is relatively insensitive, that is, blue light. By interposing a filter in the path of the scanning beam, the spot of light in the lens which projects it is seen as a blue disc of light not bright enough to interfere with clear vision of the neon lamp which provides the image of the person located at the distant end.



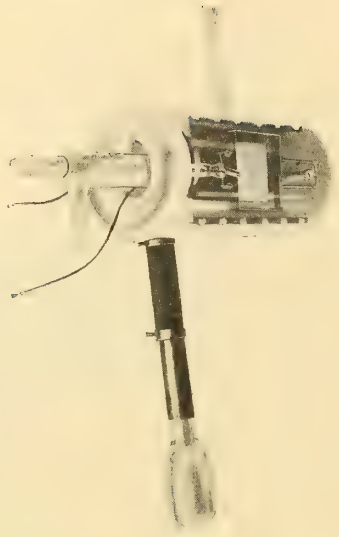
View of direct scanning system, showing camera diaphragm and lens, the aperture plate, the scanning disc and the lens which concentrates the light into the p. e. cell. Carefully shielded amplifiers occupy the boxes

In our original demonstration of one-way televison, scanning discs were used which had fifty holes arranged in a spiral. With this number of holes, it is possible to secure a definitely recognizable representation of the human face. It was decided, however, that for the two-way system a degree of definition should be provided such that faces were rendered in an entirely recognizable and satisfactory manner. Accordingly the number of scanning holes has been increased to seventy-two, which provides just twice the number of image elements. The transmission band is, of course, doubled by this change, requiring wire connections of considerably higher quality than heretofore.

When a seventy-two hole scanning disc is used the component frequencies of the image signal encompass a range of from 10 cycles to 40,000 cycles per second whereas intelligible speech may be reproduced by a signal wave whose component frequencies cover a range of 2,500 cycles per second. This comparison indicates roughly how much more difficult it is to transmit high quality television images than it is to transmit ordinary speech. In general the electrical



A general schematic of the first practical television system



Water-cooled neon lamp with hydrogen valve as used for television reception. While in operation the central rectangle glows with a pinkish light

features of the apparatus are similar to those previously used, although in the interval improvements and refinements have been made in many directions.

Light reflected into the photo-electric cells gives rise to an alternating electric current whose effective value is of the order of a ten-thousand-millionth ampere. The neon glow lamp on which the image is received at the distant station reproduces the image satisfactorily when the effective value of the alternating current is of the order of one-tenth ampere. This thousand millionfold increase in current variation, considerably greater than required for the earlier one-way system, is effected by amplifiers in which the vacuum tubes are coupled by condensers and resistances. The tubes, which operate at low energy levels, are shielded against electrical, mechanical, and acoustical interference.

For the transmission of images between 463 West Street and 195 Broadway, the appropriate stages of the amplifier system are coupled by special transformers to telephone cable circuits equipped with special distortion correcting networks which are capable of transmitting the extremely complex current variations without distortion. The amounts of distortion inherent in other parts of the system are either kept small by design or annulled by means of correcting networks.

Synchronizing Arrangement

An indispensable part of a television system is the means for holding several scanning discs accurately at the same speed. For the two-way television system, a simplified and improved synchronizing arrangement is used. The discs at the receiving and transmitting ends, which rotate at a speed of 18 revolutions per second, are synchronized by means of a vacuum tube oscillator located at one end of the line and delivering a frequency of 1275 cycles per second at a low power level. This frequency is transmitted over a separate pair of wires.

At the receiving end this frequency, through vacuum tube means, controls the field strength of the motor and thereby holds its speed exactly proportional to the frequency. In the same way, the speed of the motor at the transmitting end is controlled by a similar vacuum tube circuit so that its speed is also proportional to the frequency of the same oscillator, and thus the motors driving the scanning discs at both ends of the line are held in synchronism. By using a frequency of 1275 cycles per second, the degree of synchronization is held within sufficiently close limits to keep the picture at the receiving end central within its frame within a small fraction of the picture width. Novel features of this synchronizing system are the use of mechanically damping couples between the discs and the motor shafts to improve the steadiness of the image, and of an electrical phase shifter for framing the images.

Electron-bombardment of the argon molecules in this tube produces light rich in blue and green rays



Acoustic Considerations

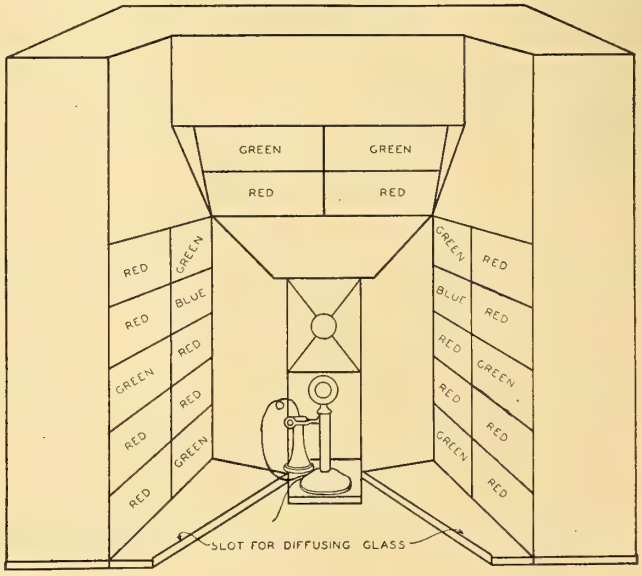
The acoustic portion of the two-way televison system is unusual in that it permits simultaneous two-way conversation without requiring either person to make any apparent use of telephone instruments. It is obviously desirable to arrange the acoustic system in this way because the ordinary telephone instrument conceals part of the face and would thus prevent the system from approximating to the conditions of ordinary face to face conversation. The elimination of telephone instruments is accomplished by the use of a microphone sensitive to remote sounds and a loud speaker concealed near the television image at each station.

The microphone at one station is connected through suitable vacuum tube amplifiers and a telephone circuit to the loud speaker at the other station. This permits conversation in one direction while a similar connection between the other microphone and loud speaker permits conversation in the other direction. The persons using the system then communicate as if face to face and with no telephone system apparently involved.

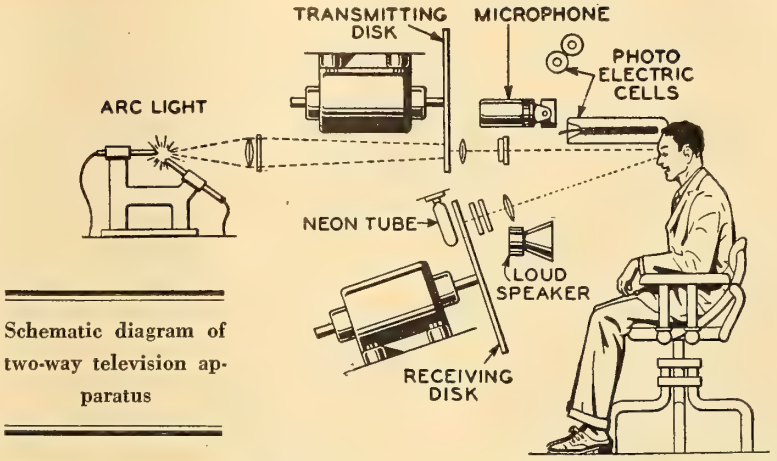
In order that the transmitted sounds be familiar and natural, distortion in the sound transmission system has been reduced to a minimum. The microphones are of the condenser type used extensively in radio broadcasting and sound picture recording. Being of small size, they are readily concealed near the television image in the most advantageous position for picking up the voice. The loud speaker, also of small size but capable of reproducing a broad frequency range, is likewise concealed near the television image, so that the sounds produced appear to emanate from the image itself. This loud speaker is of the moving coil type with a small piston diaphragm.

In any system such as that described, the microphone is not capable of distinguishing between the sounds from the local speaker or from a speaker at the remote end of the cir-

The grouping of the color filters in front of the color-sensitive photo-electric cells is shown in this sketch



cuit reproduced locally by the local loud speaker. If the sounds from the local loud speaker should be impressed upon the local microphone in sufficient magnitude, "singing" would result, and the system be no longer operable. To prevent this the microphone and the loud speaker are installed in carefully chosen positions and the inner surfaces of the soundproof booths are specially treated to prevent as much as possible the reflection of sounds from the walls into the microphone. Under these conditions, the attenuation of sounds transmitted is of about the same magnitude as would be experienced if the listener were say 10 or 12 feet away but in the same room. This acoustic illusion of distance is in harmony with the visual appearance of the television image.



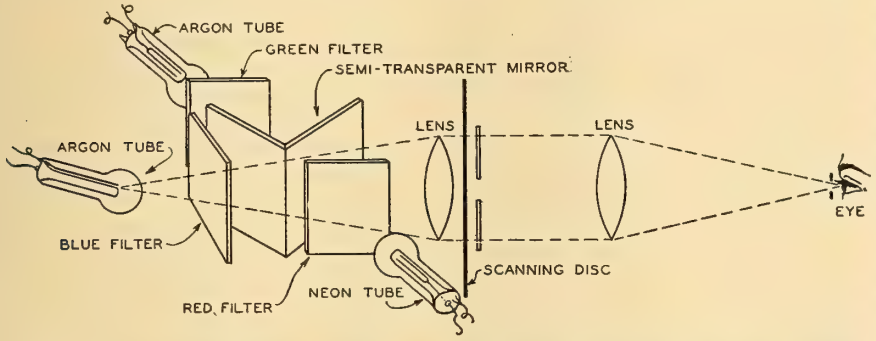
Schematic diagram of two-way television apparatus

Signal and Monitor System

In addition to the television synchronizing and acoustic circuits, others are provided for signaling and monitoring purposes. Matters are so arranged that an operator can see both the outgoing and incoming image, and by means of movable lens and prism systems can insure that the scanning beam is properly directed to correspond to the height of the observer and that the magnifying lens in front of the receiving disc directs the image to the observer's eyes.

Operating arrangements are made so that the two parties to the conversation, after taking their positions in the booths, do not see or hear each other until adjustments are made, whereupon the operators expose the images and connect the talking circuits simultaneously. The experimental service is arranged on an appointment basis.

The two parties to the conversation, having arranged with attendants at the two stations for their time, proceed to the respective booths, where they are ushered into chairs in position before the photo-electric cells and instructed as to the operation of the system. Immediately the attendant closes the booth door; the operators make the necessary adjustments; and the simultaneous sight and sound communication is carried on until, upon the parties leaving their chairs, the connections are interrupted.



One semi-transparent mirror reflects red light from the neon tube; one reflects green light from the argon tube; and through both mirrors passes blue light from the other

"Yellow Dog" Contracts

LAUDED on all sides by leaders of liberal thought is the speech of Senator Hiram Johnson of California during the recent debate on the nomination of Judge Parker of North Carolina for the Supreme Court bench. The appended remarks are concerned with the so-called "yellow-dog" contract under which an employee is asked to forfeit his right to align himself with any labor union organization so long as he remains in the employ of the company tendering him the contract. Senator Johnson's speech is the subject of warm praise by labor leaders everywhere, and wide circulation of it is desired by them. The speech, in part, follows:—

"I read just a line of the 'yellow dog' contract, so called, in order that it may be in juxtaposition to some words that I wish to read of a man whom it is unfashionable to quote nowadays here or perhaps in this materialistic age to utilize as an authority upon any subject whatsoever. These are the controlling provisions of the contracts that have been the subject of discussion:—

" 'That during his employment said employe will not become a member of any labor union, and will have no dealings, communication or interviews with officers, agents or members of any labor union in relation to membership of such employe in any labor union, or in relation to the employment of such employe.'

"Again:—'I agree, during employment under this contract, that I will work on efficiently and diligently, and will not participate in any strike nor unite with employees in concerted action to change hours, wages or working conditions.'

"Words utterly fail me in characterization of contracts such as that. I care not whether they have been enforced by the one court or another; they are void as against public policy.

"Socially they are wicked and destructive of ordinary human relations. Economically they are unsound as resting upon necessity on the one hand and coercion on the other; and morally they are infamous, denying fundamental rights and disrupting the dearest human associations. . .

" 'Socialistic,' says my friend from Ohio (Mr. Fess), are assaults that are made upon the Supreme Court in this chamber.

" 'Socialistic,' re-echoes man after man in relation to what may be said about this applicant or another. Socialistic to stand here and denounce a contract such as that.

"Socialistic—and exactly the same epithet was hurled in the United States some years ago upon another case of like character, the Dred Scott decision, wherein human liberty was at stake; no more important than this, where industrial freedom is at stake.

"Lincoln dared criticize a decision of the Supreme Court. He said, coining a word, that it was an 'astonisher,' and that he 'went for reversing it.'

"I say to you, paraphrasing what Lincoln said, this decision upon the 'yellow dog' contract is an 'astonisher,' and I go for reversing it, as Mr. Lincoln said, in any fashion by which I may voice that endeavor to reverse; and here comes an opportunity finally for us, in the Senate of the United States, to voice our views upon this inhuman, this cruel and this wicked contract that rests upon the necessity of human beings and the hunger of innocent women and innocent children."

Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

FROM the output of the Western Electric Amplifiers we pass to a horn control panel, which is called the 200-A panel. This unit includes a step down auto transformer, with a number of intermediate taps. The results would be very poor if the amplifier output would be connected directly to the horn unit. The output impedance of the 43-A amplifier is 500 ohms. The impedance of the horn unit is approximately 16 ohms. It is obvious that these impedances would not be matched, if we were to connect the horn unit directly to the output of the power amplifier. Matching of impedances is accomplished by the use of the auto transformer.

There are seven dial switches on the 200-A panel. These switches make it possible to secure the correct energy level with any combination of speakers. A 50-ohm resistance is connected in the monitor horn circuit, for the purpose of reducing the volume to the desired level in the projection room. The number of horns required in any theatre is governed by the size of the auditorium.

Horn Settings

Assuming that the amplifier side of this transformer is 500 ohms, if we tap this transformer including only a few turns, we will step down the impedance; if we take these turns in the ratio of the square roots of 16 to 500, we will match up the 16 ohms to 500. That is the function of the 200-A panel. Regardless of the number of horn units, they have to be balanced.

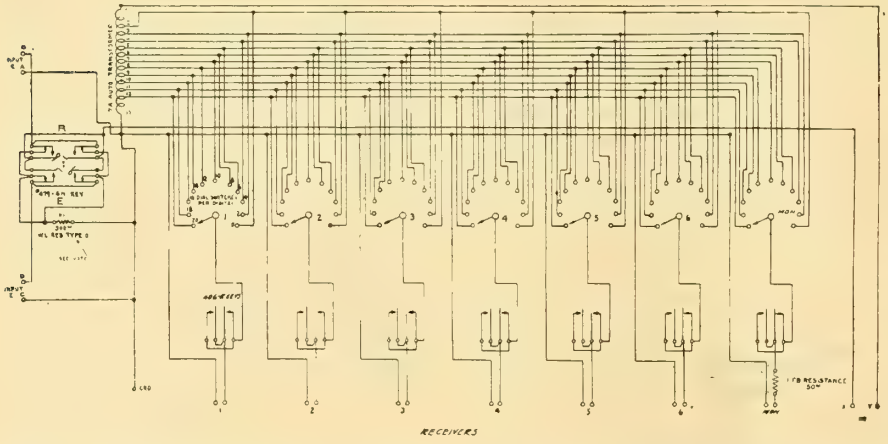
We used to have A, B and C settings for the horns, when they were installed two upper and two lower; however, these settings have been eliminated. After the horn setting on the 200-A panel is established by the engineer, it is not varied.

The output control panel used with newer installations is the 209-A panel. It is practically the same, with the exception that the dial switches have been eliminated, because different settings for horns are no longer used. The taps for matching the impedance is made at the back of the panel in a permanent manner. Key switches for each individual horn are still requisite on this panel so that they may be turned on and off as desired.

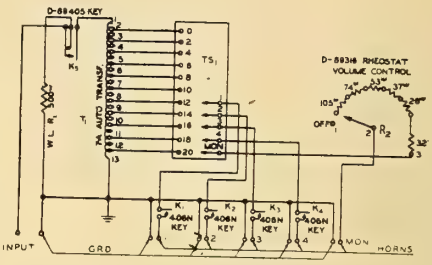
An adjustable rheostat is connected in the monitor circuit for the purpose of obtaining the desired volume level in the projection room. The horn control panel has given very little trouble. We have had occasions, where a speech circuit would become shorted, which would immediately stop the sound; however, the location of this short is easily detected by turning off each individual horn switch until you have located the speech circuit, which is shorted.

Speech Circuits

Troubles in speech circuits can usually be located by making a test



Western Electric 200-A horn control panel. Note the 7 switches on this panel. These switches make it possible to obtain any distribution of energy level with any combination of horn units. It is very important, when the switching is changed on this panel to see that the horn dial switches are in such a position that the brush makes contact only on one stud. If any one of these switches, including the monitor horn, is left on two contact studs, a short circuit on the output of the power amplifier will take place, which will result in poor quality of reproduction. Note a 50-ohm resistance is connected in series with the monitor horn circuit. This is for the purpose of reducing the volume in the projection room to the desired level. This resistance can be removed if more volume is required



Western Electric 209-A horn control panel. Note the dial switches are omitted from this panel; however, individual key switches are provided for the purposes of controlling the speech circuits as desired. Taps are provided at the rear of this panel for matching the impedance of the horn units.

at the rear of the panel with a headset. The speech circuits run directly from the horn output panel to the horn units back stage. However, these circuits do pass through the "B" box.

The polarity of these circuits is indicated by color, which runs from the horn output panel to the "B" box. With the newer installations, one neutral wire is run, along with the positive leads, which are required for the number of horn units in use. These leads terminate at a terminal strip in the "B" box. The neutral wire is white and the positive leads are black. However, the polarity from the terminal strip in the "B" box is identified by another color, to the horn units.

A red tracer identifies the positive lead, which is connected to L 1 on the speech circuit and a green tracer identifies the negative lead, which is connected on L 2 of the speech circuit on the horn unit. It is imperative that projectionists test each individual horn unit daily before the show starts, and be assured that it is performing properly. We find that the projectionist is faced with a problem of determining the proper value of resistance providing a rheostat burns out and the resistance is not indicated on the rheostat. It is necessary that every projectionist have a working knowledge of Ohms Law.

Determining Resistance

In order to find the resistance in ohms that should be provided in a rheostat for any given work, we must know the voltage of the battery or power supply which supplies the current, the filament voltage at which the tube is rated to operate, and the rated number of amperes through the filament at this voltage. From the

number of volts furnished by the battery subtract the number of volts at which the filament should operate, then divide this difference by the number of amperes that should flow through the filament.

To find the number of amperes that must be carried by a rheostat which controls more than one tube, multiply the amperage for one tube by the number of tubes.

Line Voltages

A. C. line voltages throughout the country are not the same and they vary considerably. It is surprising that a leading sound equipment company installs their sound equipments and leaves the exhibitor with a burden which proves to be quite expensive. We all know that certain amplifiers are not provided with power transformers with variable taps on the primary to permit satisfactory operation on different line voltages. It is a fact that the line voltage in some districts is 115 volts and in many instances 125 volts.

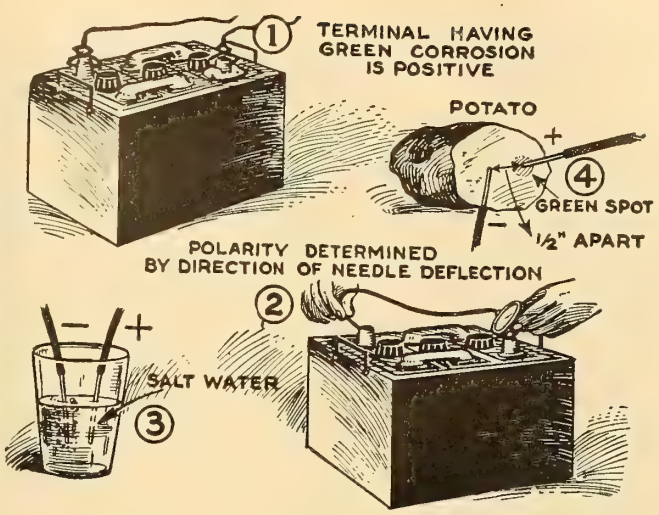
The replacement of vacuum tubes has been enormous in the Western Electric 42-A and 43-A amplifiers. The filaments of those amplifier tubes are lighted from A. C. They are supposed to operate at a certain definite voltage. Above this voltage the filament deteriorates rapidly and burns out. We have found that this has been the direct cause of so many replacements with 211-E Western Electric vacuum tubes.

Longevity Guarantee

Incandescent lamps, vacuum tubes and many other things have a guaranteed number of burning hours. This does not signify that the lamp or tube is to be thrown away after the guarantee is used up. Guarantees of this kind are only used to protect the consumer against defective workmanship. We have some sound equipments which have never had a vacuum tube replacement and the reproduction is very good in these instances. However, there are other theatres which are always having difficulty and upon following these cases through to a conclusion, we have found the line voltage exceedingly high, where A. C. is used to light the vacuum tube filaments. It must be remembered that the life of anything depends upon the care it receives and this particularly applies to vacuum tubes.

Voltage Test

Whenever in doubt about the line voltage, secure A. C. voltmeter and see for yourself if the voltage is about 110 volts. If you find the line voltage above 110 volts and varying over wide limits, one of the first things to do is to write a good stiff complaint to the power company. We have installed voltage regulators, where the voltage varies over wide limits, sometimes being high, sometimes normal and at other times quite low. If the voltmeter test shows the line voltage to be quite high, but uniform, a fixed resistance of the proper value can be used.



Four different methods of determining polarity. It is always advisable to be sure the polarity is correct before making permanent connections. Where battery terminal markings have been effaced, one of the above methods can be used for determining polarity

Defective Tubes

When an internal short develops in a vacuum tube discard it immediately. A short circuit of the arrangements in a vacuum tube is very difficult to trace. Do not place a defective tube in the spare parts cabinet, as it may get mixed up with the good vacuum tubes and when you are in a hurry you may grab the defective tube, which may prove serious.

Battery Care

Batteries sometimes lose their capacity because the active material has fallen from the plates. This effect will be observed by the inability of the battery to deliver or take an appreciable charge. The remedy is to have the worn-out plates replaced with new ones. A hopeless case is the short-circuited cell of a storage battery. Sometimes the material that has fallen off the plates piles up under them and short-circuits them—thus causing one or more of the cells to lose its voltage or to lose its charge rapidly.

On the other hand, there are many cases where a battery neither behaves badly, nor does it perform well. It has no short-circuited cells, nor does it rapidly lose its charge. But it cannot be charged to the usual specific gravity. Sometimes the batteries which are in this condition can be revived. The following treatment can be used where the plates of a cell are still in good condition, but have become sulphated and hardened.

In the process much of the sulphate is removed and the plates are softened. All the acid, in the first place, must be taken out of the cells. New acid is then added and the battery charged. At first, the battery must be charged slowly. When the specific gravity has reached its maximum value, the charging of the battery should be stopped and all the acid should be drained from the cells. Then they may be refilled with distilled water and the battery discharged through a 6-ohm resistance which is placed across the terminals. The discharging operation will require about 24 hours.

Charging Operation

After discharging, the battery should be charged again for about 12 hours at not over 10 amperes and then the charging should be continued at a much slower rate for about 15 to 24 hours more for the purpose of removing any excess of acid from the plates and to take sulphate deposits from them. This process should be repeated at least twice and possibly three times, removing all the water remaining in the cells and refilling them with fresh distilled water.

After this the cells may be filled with a new acid solution which should have a gravity of 1,200 or 1,250. As soon as the new acid solution has been put into the cells the gravity of the electrolyte drops to some extent, due to absorption by the plates. The gravity rises again as soon as the battery is again charged. The charge should be continued until the gravity test is nearly up to the value stated above. The cells of the battery are then ready for service.

Every projectionist must be sufficiently interested in the equipment he is operating, so that he may be able to make corrections in faulty operation. Good tone quality is the ability of an amplifier to evenly and faithfully amplify and reproduce in sounds the music, voice, or other material from the original natural source. All frequencies, from the lowest to the highest, should be amplified to the same extent without exaggeration of some frequencies and suppression of others.

No Screen Co. Merger

Raven Screen Corp. of New York has issued a denial of the story published recently to the effect that Raven was included in a consolidation of several large screen companies.

Fundamentals of Auditorium Acoustics

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IT has been pointed out that the aim of sound reproduction is to produce sound similar to the original music or speech as near as possible, that is, to obtain an exact likeness of the original sound. The conditions necessary to obtain good sound reproduction in an auditorium are:—that the sound should be of sufficient loudness in all parts of the auditorium, that the original quality of sound should be maintained, that the successive sounds in speech and music should be clear and distinct, and that extraneous noises should be absent.

Obviously, to fulfill the conditions necessary for ideal sound reproduction requires that all forms of distortion introduced by the studio acoustics, recording equipment, sound film, reproducing equipment, and house acoustics be negligible. The importance of good room acoustics has become fully recognized since the advent of sound pictures.

Our everyday dependence on sound has made the observation of the more usual acoustic defects in auditoriums the common experience of everyone. Each of us at some time or other has noticed an echo, a distinct repetition of sound, from a hillside or the wall of a distant building in the open, or, more often, from a high curved ceiling or a rear wall in a theatre. Likewise, everyone has experienced reverberation, a blurred prolongation of "after" sound, when talking or shouting in a hard tiled wall swimming pool or in an empty hard plastered corridor or in a completely marbled lobby.

Nature of Sound

Again, each has noticed the phenomena of resonance, the tendency of certain notes to be over-emphasized in a powerfully resonant room, such as a small tiled bathroom or a small marbled alcove.

Before discussing the action of sound in a room let us review the fundamentals of sound.

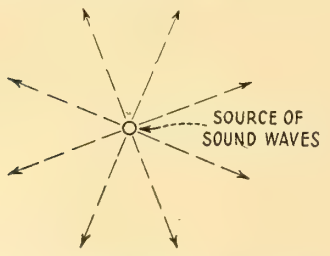


Fig. 1—Propogation of sound from a point source

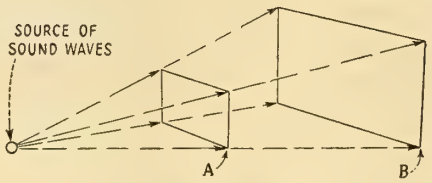


Fig. 2—Dispersion of sound

Sound is a form of wave motion and as such has definite characteristics. Upon the *amplitude* of the wave motion or vibration depends the *loudness* of sound; upon the *frequency* of vibration (cycles), depends the *pitch* and *quality* of sound; and upon the relation existing between the direct and reflected waves depends the *intelligibility* of speech sounds, and the *clearness* of musical sounds.

Sound is a form of energy. We have learned that sound energy is produced by a body vibrating at audible frequencies feeding into a sound medium, through which the sound energy is propagated at a definite velocity, and in which the sound energy is detected by setting the eardrum into vibration and hence producing the proper sensation in the brain. The velocity of sound in air is approximately 1,120 feet per second at ordinary room temperatures.

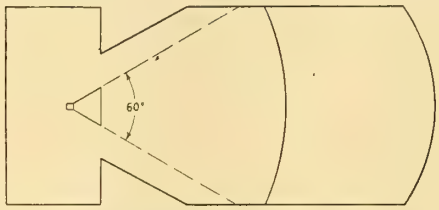


Fig. 3—Horizontal range of sound beam from loud speaker

For purposes of discussion, except where noted otherwise, we shall consider that our sound source is a point source, that is, one from which the sound energy is emitted equally in all directions. We can consider this spherical wave as being made up of many sound rays, one traveling in each direction, and all coming from the same point, as shown in Fig. 1. According to the law of diminishing intensity, the greater the distance the wave has traveled the less intense is the sound, and consequently of lesser sound loudness.

Figure 2 shows why the loudness of sound diminishes with distance. At "A" a certain amount of sound energy is concentrated in a fairly small area. As the sound waves move along to "B" the area of cross-section within which this sound energy is confined increases so that the same amount of sound energy is spread over a greater area, reducing the loudness of the sound.

Most of the loudspeakers actually used in theatres today are very directional and are not point sources. For practical purposes the energy which they radiate may be considered as being confined within a 60° angle in the direction of the long axis of the baffle mouth (laterally), as shown in Fig. 3; and within a 30° angle in the direction of the short axis of the baffle mouth as shown in Fig. 4.

Properties of Sound Waves With Reference to Acoustics

Sound waves display the properties of reflection, absorption, transmission, dispersion, and interference. We shall take up most of these properties in their application to auditoriums in what is to follow.

When a sound wave strikes the boundary between two different mediums its energy is partially reflected, absorbed, and transmitted as shown in Fig. 5. For the purpose of illustration the sound is shown as a concentrated beam striking a wall. The arrow points indicate the direction of travel. The lines representing the sound beam are shown of different width to give an idea of the variations of loudness. When the beam of sound waves strikes the wall, part of it is transmitted as illustrated by the arrow penetrating the wall, part is reflected, and part is absorbed. The sound energy absorbed is in reality transformed into heat energy and, therefore, no longer exists as sound. The sum of the energies of the transmitted sound, absorbed sound, and reflected sound is equal to the energy of the initial sound beam.

The reflection of sound is in many ways analagous to the reflection of light and water waves, and therefore obeys the law of equal angle of incidence and reflection. Thus in Fig. 6 angle "*i*" equals angle "*r*." Also by analogy to optics the reflected sound "R" appears to come from its image source "S." The rebound of a billiard ball off the table cushion resembles the reflected ray of sound from a flat surface. In this case, the angle which the path of the ball makes with the cushion as it bounds away is of the same degree as the angle

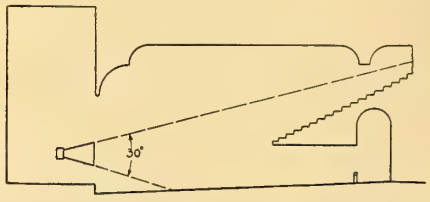


Fig. 4—Vertical range of sound beam from loud speaker

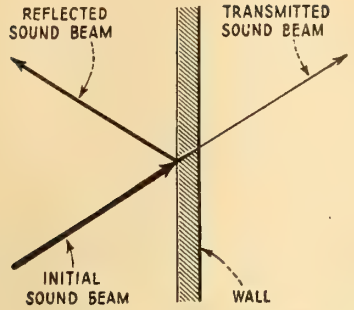


Fig. 5—Reflection, absorption and transmission of sound

which the path of the ball made with the cushion as the ball approached it.

Reverberation

The action of sound when confined in an enclosure is much more complex as compared with its action in free air. In free air, only the direct sound from the source can be heard. In a room, however, the sound one hears is composed of both the direct and the reflected waves. Consider the travel of a single ray of sound from the source "S" in Fig. 7.

As it proceeds as part of the expanding spherical sound wave, it first meets with a surface where it suffers partial reflection, absorption, and transmission. The reflected portion now continues until it strikes a second surface, where it again suffers partial reflection, absorption, and transmission. This process is repeated until the sound ray is completely dissipated. Likewise, all other portions of the spherical wave undergo this same process of multiple reflection.

In an ordinary room with plaster walls and ceiling, due to these successive reflections the sound energy is rather quickly diffused throughout the entire room. In such a room the sound will suffer from 200 to 300 reflections before its energy is completely dissipated. If we recall that sound travels 1,120 feet per second, it is readily seen that the duration of this prolonged "after-sound" (called the reverberation time of the room), will be several seconds for the average theatre.

Probably we can obtain a better mental picture of reverberation by using optical analogy again. Let us imagine that we have a room with mirrored walls and both a source of sound and light at the point "S" as in Fig. 8. If an observer is stationed at "A" he will see the object and hear the direct sound, not only at "S" but he will see the images and hear the reflected sound also from the sources "S1," "S2," "S3" and "S4."

These images form the first reflections and are reflected again, and likewise the second images are reflected, forming a new set of images. Obviously the successive images are farther and farther away so that the image the farthest away would be the faintest in loudness. Optically, one stationed at "A" would see many images of "S" in all directions.

The effect of reverberation is to cause blurred speech and music, due to the overlapping of the successive syllables in speech. Up to a certain point this overlapping is apparently beneficial because it increases the loudness of sound, but beyond this optimum point overlapping of successive syllables is detrimental. Thus, there is a period of reverberation, depending on the size of the auditorium, which will give *optimum* results. Although reverberation greater than the optimum is detrimental, it is tolerable

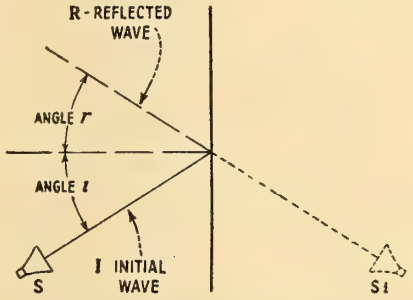


Fig. 6—Reflection of sound

if not excessive. Thus, there is a time of reverberation greater than the optimum period which will give *acceptable* results. In general, reverberation time should never be much greater than two seconds.

The audience in any theatre causes the time of reverberation to vary, for each auditor absorbs a large quantity of sound. It is therefore desirable to have optimum results obtained for the average size audience and acceptable results for the minimum size audience entertained in the auditorium.

The reverberation time of a room, which is the time required for a sound of given initial intensity to die away to the point where it is just barely

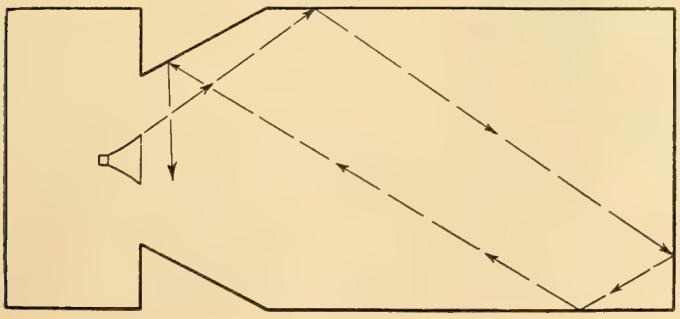


Fig. 7—Reflection of sound in an auditorium

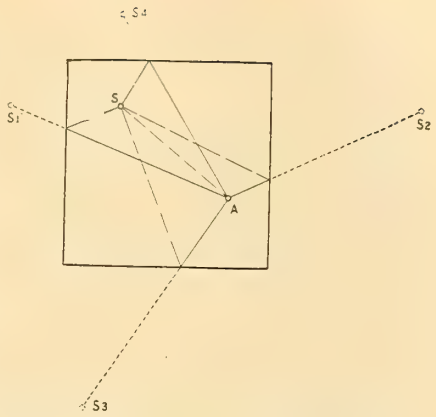


Fig. 8—Similarity of reflection of light and sound

audible, depends directly on the loudness of sound and the size of the room, and depends inversely on the absorption in the room. The standard reverberation time of a room is the reverberation time obtained when using an initial intensity of 1,000,000 times the intensity of the faintest sound which can be heard. This represents a sound volume of six times the loudness of a sound barely audible.

Increasing the size of a room increases the reverberation period due to the fewer number of reflections which occur in it during a given space of time, although the total number of reflections remains approximately the same.

(To be continued)

Roosevelt Memorial Medal to William F. Green

ROOSEVELT, the American, said: "If I must choose between righteousness and peace, I choose righteousness." The strenuous ardour of the man has been preserved in the memory of the nation by the Roosevelt Memorial Association. This body (since 1923) seeks to discover each year those Americans who best epitomize the spirit of Roosevelt in choosing righteousness rather than peace. This year William Green, Rear Admiral Byrd and Hastings Hart are honored. This is the first time that a labor man has received the award.

That the award carries with it real distinction is evidenced by the list of recipients. In 1923, the medals were awarded to Miss Louisa Lee Schuyler, to Dr. Henry Fairfield Osborn, and to General Leonard Wood. President Harding presented the medals personally in the White House before a gathering of notables in the East Room, which included members of the Cabinet, Ambassadors and distinguished officers of the Army and Navy.

Many Notables Recipients

In 1924, the medals were awarded to Elihu Root, to Oliver Wendell Holmes and to Charles W. Eliot; in 1925, to Gifford Pinchot, to George

Bird Grinnell and to Martha Berry; in 1926, to William S. Sims, Albert J. Beveridge and to Daniel Carter Beard; in 1927, to John J. Pershing, to Herbert Hoover and to John Bassett Moore; in 1928, to Charles Evans Hughes, to Frank M. Chapman and to Charles A. Lindbergh; in 1929, to Herbert Putnam, to Owen Wister and to Owen D. Young.

The Roosevelt Medal, which is three inches in diameter and of solid gold, shows on one side a head of Theodore Roosevelt and on the other a flaming sword with the motto: "If I must choose between righteousness and peace, I choose righteousness." It was designed by James Earle Fraser.

For Distinguished Service

In making the award to President Green the Roosevelt Memorial Association said:

"William Green receives the Roosevelt Medal for distinguished service in the cause of industrial peace. As president of the American Federation of Labor he has both symbolized and directed the new policy of co-operation in industry, representing the American conception of industrialism and self-reliance, and fighting with vigor and success the disruptive influence of the radical element preaching communism and class war. In a period of unrest and readjustment, he has prevented conflict, and at the same time strengthened the position of the trade union in the social order. It has been said of him that no man realizes better than he 'how materially dependent are the interests of capital and labor.' He himself has said, 'Our work must be constructive in character, educational and progressive.'

Trade Union Progress

"Co-operation, as the method, and the union, as the instrumentality, represent his program. His greatest contribution to industrial progress has been the emphasis he has placed on the constructive possibilities of the trade union. He regards the union as a national institution with responsibilities as well as rights; and under his leadership it has become more and more the instrumentality through which the workers contribute to the solution of industrial problems and participate in industrial and social progress.

Advisory Council Adds Many Members

EVERY day sees the membership roster of the Projection Advisory Council gaining one or more members. The Council is now truly national in all respects, and the growing membership representation in all states and in provinces of Canada augurs well for the campaign which the Council will launch early in September.

President Thad Barrows reports much enthusiasm for the Council throughout the country, many sections of which he visited while on his trip to the I. A. Convention in Los Angeles. Lawrence Jones, Secretary, has just returned from a European trip, and he reports that inquiries about the Council came thick and fast on his journey, particularly in England.

New Members

A partial list of recent new members of the Council is appended hereto:

Harvey H. Franklin, San Bernardino, Calif.; Paul E. Kline, Balboa, Canal Zone; Thomas P. Swist, Manchester, N. H.; George A. Higley, Cambridge, Mass.; William Reardon, Miami, Florida; Maurice N. Blakemore, Larchmont, N. Y.; Benjamin Norton, Brooklyn, N. Y.; Sam Glauber, Brooklyn, N. Y.; Morris Heller, Brooklyn, N. Y.; George J. Van Deurs, Brooklyn, N. Y.; Harry Bergoffen, New York City; Sidney Wein, Brooklyn, N. Y.; J. M. Wall, Syracuse, N. Y.; William Marten, New York City; L. F. Vogel, Norfolk, Va.; J. A. Russell, Portland, Maine; John F. Gatelee, Springfield, Mass.; Louis Phillips, New Haven, Conn.; Henry F. Gleken, Dorchester, Mass.; Maurice R. Watts, Manchester, N. H.; John L. Creed, Brockton, Mass.; Frank Motta, Brockton, Mass.; Leon X. Marchand, Brockton, Mass.; George F. Williams, New York City; Louis Pirovano, Boston, Mass.; Herbert S. Dill, Boston, Mass.; Harold J. Sheerer, Boston, Mass.; W. Edwin Grant, Dorchester, Mass.; Charles E. Jandrue, Jamaica Plain, Mass.; Meyer Bixgorn, Boston, Mass.; Timothy Garren, Waterbury, Conn.; A. V. Birkholm, New York City; Arthur A. LeBlanc, Brighton, Mass.; George Christena, Miami, Fla.; Hoyt B. Parr, Miami, Fla.; Raymond Creelman, Miami, Fla.; Charles R. Conner, Miami, Fla.; Robert E. Lewis, Miami, Fla.; Leo Westfield, Boston, Mass.; Harry Rosendorf, Boston, Mass.; H. E. Alford, Los Angeles, Calif.; Arthur A. Smet, Manchester, N. H.; Joseph Rosen, Boston, Mass.; Maurice Rothenberg, Boston, Mass.; Jacob Abramovitz, Boston, Mass.; James B. O'Brien, Jr., Dorchester, Mass.; Jack Rosenberg, Cambridge, Mass.; Charles W. Crawford, Olympia, Boston, Mass.; Charles Cifre, Boston, Mass.; Fred Hookailo, Olympia, Boston, Mass.; Eddie Comi, Boston, Mass.; Ernest G. Comi, Boston, Mass.; James L. Caddigan, Boston, Mass.; Alexander Lessoff, North Cambridge, Mass.; William J. MacIsaac, East Boston, Mass.; Ernest F. Costa, Boston, Mass.; Aaron J. Kaufman, Mattapan, Mass.; Leon A. Narbut, Jamaica Plain, Mass.; Paul Brown, Boston, Mass.; Donald McRae, Chicago, Ill.; F. E. Castle, Jr., New York City; James C. Dunn, New York City; Steve Barutio, New York City; George Halliday, Columbus, Ohio; Irwin D. Rathstone, New York City; H. B. Braun, New York City.

"Colorscope" A Marvel of Precision

THE physicist has again invaded the field of optics, and a function heretofore left entirely to the human eye has been relegated to a laboratory apparatus of such simplicity of operation that it can be handled much as a modern radio set. The new "colorscope," was built for the mechanical matching of two colors to a degree much closer than the eye could possibly achieve, and publicly demonstrated recently by Dr. H. H. Sheldon, Professor of Physics, New York University, who with his assistant, Dr. W. A. Schneider, Associate Professor of Physics at the same school, developed this remarkable new instrument, the possible applications of which lead into all branches of work in which color is used.

The principle of the "Colorscope" based on the photo-electric cell, already famous for its extensive applications in the control of sensitive apparatus, etc., by its reaction to light beams which make it give off infinitesimal electric currents capable of operating relays which in turn will start or stop machinery, operate graph needles, or perform other such laboratory and shop service. In this particular apparatus, two photo-electric cells (of any one of the sensitive material, such as potassium hydride, ceasium, selenium, thorium, etc.), are used, creating a "balanced" circuit under a normal light source. That is, they are connected to a galvanometer in such a manner that when both receiving the same amount of light they will hold the needle at zero. If one or the other receives more light, movement is produced from it and the needle will deflect to the side registering the heaviest radiations.

A piece of the material, a sample of dye, or any standard color to be matched, is inserted in one side of the apparatus, before one cell, and reflecting the light from a single light source into the cell. The needle is now brought to zero by a dial control similar to a radio tuning dial. A sample of another material of supposedly similar color, or of another vat of dye, etc., is set before one cell in place of one of the standard samples. If there is a difference of shade, even though it be too slight for the human eye to detect, the galvanometer needle will slip off—if darker, toward the standard sample, if lighter, toward the test sample. A variation of three points either way will register a shade difference of enough importance to be considered faulty matching; although it has been found that a variation up to six is often undiscernible to the naked eye.

Recording Technic for Sound Pictures

By J. P. MAXFIELD

II*

IT is now time to consider how much the microphone must be moved when the lens is changed. With sets built in the manner to be described later, the microphone should be as far away from the foreground action as it would be necessary to place a 30 to 35 millimeter lens in order to obtain the same sized image as will be obtained with the long focus closeup lens actually in use.

Fortunately, if the difference in focal length between two cameras used simultaneously is not too great, the ears' interpretation of the depth effect is not sufficiently accurate to cause any trouble. It is, therefore, possible to use a 35 to 40 millimeter lens simultaneously with a two-inch lens without difficulty, provided the depth of action is not over 12 to 15 feet. In scenes of ordinary living rooms, no trouble would be caused by this arrangement, provided the two-inch lens is not brought much closer to the subject than the shorter focus one.

Design of Sets

The next major item deals with the designs of the set, with a view to obtaining the proper conditions for the acoustic perspective. When a person listens with two ears in a real scene, he is able by his sense of direction, to pay attention to the sound coming directly from the speaker, to the partial exclusion of the reflected sound and incidental noises coming from all around him. However, with this sense of direction destroyed by the use of one ear only, he is no longer able to make this discrimination, and the reflected sounds, that is, the reverberation and incidental noises, appear to increase in intensity. It is necessary, therefore, to insure that the sets have less reverberation than would have been actually present in the real scene.

It has been found by experience, that if the walls of a three-walled set are built of materials having similar acoustic properties to those depicted in the real scene, the absence of the ceiling and end wall provide sufficient damping to render the acoustics suitable for recording. This of course assumes that the sound stage is dead, or that the set is built out of doors.

In practice, however, it would be both inconvenient and expensive to build the walls of a set of the materials that would really have been used had the scene been a real one. It is necessary, therefore, to use imitations. These substitutes should imitate acoustically the real materials as nearly as possible, and in particular should be braced sufficiently so that they do not tend to materially partake of the vibrations set up in the air by the sound.

When a set has been designed in this manner, experience has shown that the incidental noises sound more realistic and convincing and that they may usually be recorded at the time the original scene is taken. In one picture, on which this technic was used, some dramatic scenes occurred which were to be intensified by a period of sudden silence. In order to accentuate the silence, the ticking of a clock, situated on the rear wall of the set, was to be the only sound heard. The question was immediately asked what should be used to imitate the clock. The obvious answer is the clock, since it is difficult to get any other instrument to sound more like the clock than the clock does. The scene was recorded, using the clock as the source of sound, with the microphone in the normal dialogue position for the action, and a very successful sound record resulted.

"Tubby" Quality in Sets

In view of the stress that has been laid on the necessity of sets having more sound reflection than those previously in use, it might be of interest to consider why some of the sets of the past have been given what is commonly called a "tubby" quality.

There are two ways in which a set can cause the sound to persist in it for a short time after the source has stopped. The first of these methods is by reflection of sound from the walls and floor and this method is the only one which should be active to any extent. The second method is by a diaphragm action of the walls. In this case the sound sets the walls into vibration, and they continue to vibrate for a short time, thereby causing sound after the original source has stopped. This type of "hangover" usually has a decided frequency characteristic and is highly objectionable.

In the earlier sets, the spacing of the studding, and other supports for the set-wall material, was so great that the natural periods of the wall sections occurred in the same frequency region as the fundamental tones of the average male voice. This resulted in an accentuation of the low pitched frequencies of the voice, without a corresponding accentuation of the higher frequencies, which higher frequencies are responsible for both the crispness and articulation. To make matters still worse, where the sets were heavily draped, the damping material usually absorbed these high frequencies more efficiently than the lower ones.

With these early sets, which were designed in such a manner that they accentuated the low frequencies, and removed, by absorption, the high frequencies, it was practically impossible to record highly intelligible speech unless the speaker faced approximately toward the microphone. With the liver sets recommended, if the high frequencies, particularly those which carry the hissing sounds, fail to reach the microphone directly from the speaker's lips, they do succeed in reaching it by reflection from the walls of the set. It is, therefore, possible with these sets to record intelligible speech, where the speaker is facing directly away from the microphone position.

Stationary Mixer Setting

One interesting fact in connection with the use of the technic described is that the pictures recorded by it, are not run too loud in the theatre. This probably results from the fact that the reproduction is easily and comfortably understandable at the back of the theatre, without excessive loudness.

There is one more important point to stress. Except under very unusual conditions, the mixer dials should be set at the beginning of the take and not touched thereafter. In other words, the record should be made with the volume ranges demanded by the scene being depicted. This rule applies to more than 90 per cent of the recording required for pictures.

Any one who has done much mix-

(*Continued on page* 40)



Harry C. Griffin, B. A., of L. U. 38, Detroit, who will represent the I. A. at the A. F. of L. convention

* No. 1 appeared in July issue.

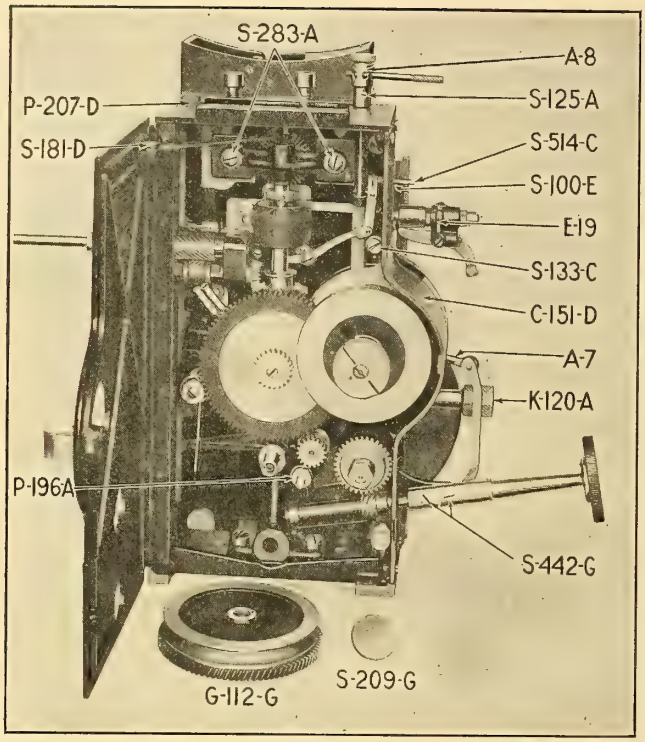


Figure 1

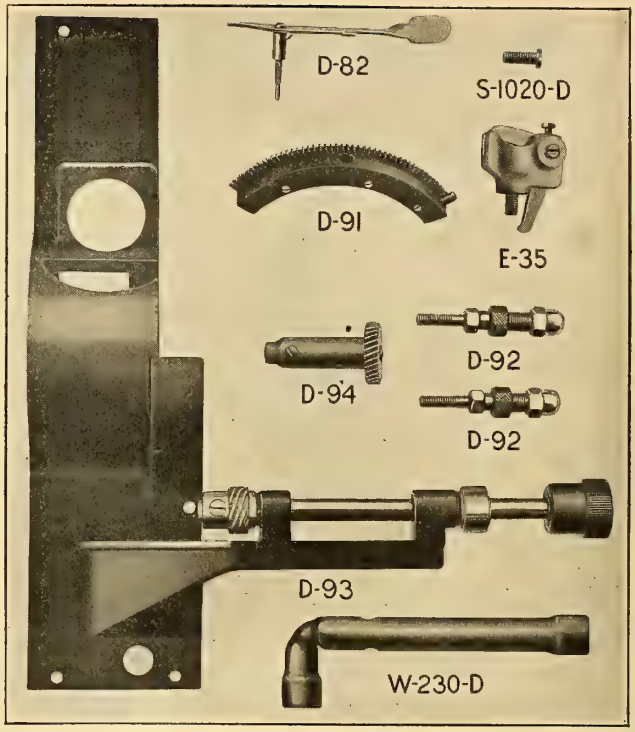


Figure 2

How to Attach New Rear Shutter Assembly to Regular Type Simplex Mechanism

TO supply the needs of theatres who have installed the regular model Simplex projectors, the International Projector Corp. has designed and placed on the market a new rear shutter assembly similar to the one furnished with the new Super Simplex projector. This new shutter assembly has been described in these columns heretofore, thus the following material will be concerned only with the instructions as to how to properly attach the assembly to all prior models.

The tools required for this work of attachment are large and small screwdrivers, a hacksaw, and pliers. The instructions follow, the key numbers mentioned being shown in the accompanying illustrations:

Remove framing lever by loosening lock nut and unscrewing lever from socket or in later type Simplex, by loosening the two set screws S-442-G, Fig. 1, which hold framing handle on shaft. Remove knurled knob S-134-E on older type mechanisms, or gate lock E-19, Fig. 1, on newer type mechanisms, being sure to remove the stud, leaving only thimble and spring; set thimble and spring to one side for a moment.

With a hacksaw saw off framing link stud A-7, Fig. 1, leaving 3/32 inch projecting from casting. Replace thimble and spring and attach new door lock E-35, Fig. 2, which will be found in envelope. Remove from envelope and dismantle as follows: Release screw S-898-E, Fig. 3, pull out eccentric pin P-380-E, Fig. 3, lift out part T-137-E, Fig. 3, turn up and let plunger P-406-E, Fig. 3, fall out. Do not remove spring S-851-E, Fig. 3, which actuates plunger.

Assemble balance to mechanism as follows: Press thimble over spring and insert fastening screw S-881-E, Fig. 3, in gate holder stud with slot in vertical position, as shown in Fig. 4, with set screw S-898-E on bottom. Pull screw S-881-E up tightly; release gate trip lever C-4, Fig. 5, and make sure that gate opens and closes freely. Do not lose spring S-851-E, Fig. 3. Insert plunger P-406-E, Fig. 3, flat end in. Pay no attention to flat on plunger—this is ground in order to prevent vacuum or pressure forming behind plunger. Replace door lock trigger T-137-E, Fig. 3, and insert eccentric pin P-380-E in position originally found. Adjust this pin until there is a minimum point of clearance between point H, and film trap casting, as shown in Fig. 4. Tightly lock set screw S-898-E, Fig. 4.

Open doors on non-operating side of mechanism. Remove front cover C-151-D, Fig. 1, by removing six screws S-122-D, attaching same to frame. (Retain all screws for future use.) Remove lower screw S-133-C, Fig. 1, replace with S-1020-D, Fig. 2, which will be found in envelope. Pull up tightly. Remove main driving gear G-112-G by removing screw S-209-G, Fig. 1, and set aside for future use.

With wrench W-230-D, provided in envelope, remove nuts, one of which

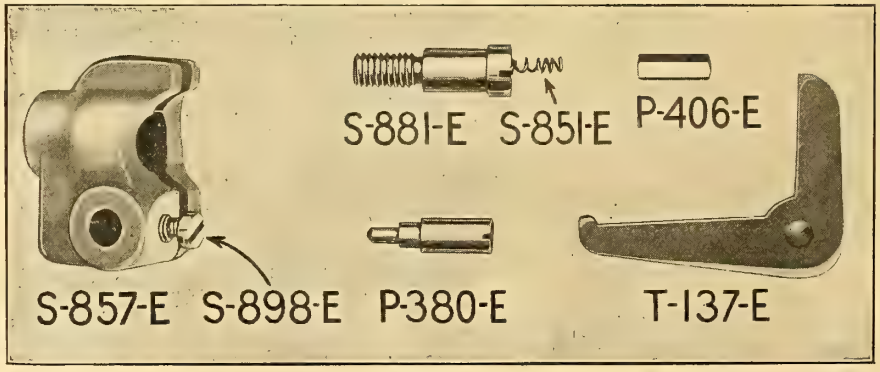


Figure 3

will be seen at N-119-G, Fig. 5, the other at P-196-A, Fig. 1. The entire framing device unit may now be removed and set aside or discarded. Set aside one nut N-119-G for future use. On older type Simplexes two nuts, washers and a spring will be found at P-196-A, Fig. 1. These should be removed as above described for the newer type equipment. It might be found necessary to drive out stud S-142-G, Plate 3, in regular instruction book. (Drive out from the threaded side.)

Remove S-100-E, Fig. 1, and replace with D-82, Fig. 2, found in envelope. (It is not necessary to disassemble these parts. The screw turns in the lever which is a lift for S-514-C, Fig. 1. Assembly is shown in place in Fig. 4.) Remove focusing knob complete, A-8, Fig. 1, by loosening set screw S-125-A, Fig. 1; set aside for future use. Remove top cover P-207-D, Fig. 1, by removing S-181-D, Fig. 1, two screws on top and one in front of mechanism which attach top plate to main frame; set aside for future use. To prevent loss of screws, insert screws in holes from which they have been taken.

Remove screws S-283-A, Fig. 1, one at a time, replacing same with stud bolts D-92, Fig. 2, found in envelope; set aside one screw S-283-A with nut N-119-G for future use. Note: *Change one screw at a time so as not to disturb the position of the vertical shaft gears.* Pull these bolts up tighty. Remove nickel plated nuts from studs and screw knurled nuts back towards mechanism. Remove shutter lift pin S-514-C, Fig. 1. If on old type mechanism this pin is not present, it is not necessary to touch the assembly. We shall be glad to furnish on request, no charge, one of these pins which may readily be inserted by the projectionist.

Let us now leave the mechanism and confine our attention for a few minutes to the rear shutter bracket assembly as received. It is necessary to disassemble this partly before going further. The entire assembly is shown in Fig. 6.

Remove shutter guard by removing the three knurled retaining screws K-141-D, Fig. 6, and lifting shutter guard from studs. Next remove revolving shutter from shaft by loosening two screws in shutter hub which clamp it to the shaft. Next remove spacing collar G-28, Fig. 7, from shaft by loosening locking screw. Behind this spacing collar will be found four steel washers W-208-G, Fig. 7. Remove these from the shaft and set aside for reassembling. Do not lose any of these washers—they are hardened and ground to exact dimensions.

The next step is to separate the attaching bracket B-325-D, Fig. 6, (to which is fastened the name plate) and shutter shaft assembly from the main unit. This is done by removing two screws S-1004-D, Fig. 6, in hub and slipping the bracket casting with shutter shaft out of its supporting bearing. When this is done the ball bearing D-81, Fig. 7, which supports the rear of the shutter shaft will slip out of its retaining ring. Set this aside for future assembly.

We can now proceed with the assembling of the unit to the mechanism. First, however, slightly bend outward and forward oil tubes marked "Oil" on Fig. 4, in order that they may clear the new shutter bracket about to be attached. The best way to do this is to insert a pin punch in the top of the tubes bending slightly outward and forward towards front of mechanism. Bend down about ¼ inch but be sure tubes do not strike micarta gear. Before going further, examine carefully new shutter shaft gear and see that no steel chips or dirt are embedded in the teeth.

Mount bracket B-325-D, Fig. 6, by slipping it over the two studs previously inserted in the mechanism to receive it. Press the bracket tightly against the main frame of the mechanism and while doing so bring the knurled nuts on the inner side of the bracket gently against the bosses on the casting. Next insert two of the screws which were removed when removing cover C-151-D, in holes marked S, Fig. 4. Pull these screws up tightly and then back off about a quarter turn. Next place the two nickel plated nuts N-202-D, Fig. 4, in position on studs, and tighten up solidly. The knurled nuts will then take the strain from the pressure applied by the nickel plated nuts and the bracket will be held securely in position.

Next tighten solidly the two screws S, Fig. 4. See that mechanism turns freely and gate locking device operates satisfactorily. If gate locking device or flywheel shaft does not operate freely, it is because the knurled nuts before mentioned are not brought tightly against casting bosses before tightening nickel plated nuts.

Replace fire shutter lift pin S-514-C, Fig. 1. Remove any cooling plate device or heat shield such as E-5, Fig. 5, which may be attached to the mechanism, leaving the fire shutter and film trap entirely exposed. Remove from envelope gear sector D-91, Fig. 2. See that projecting stud is screwed tightly into sector. Loosen the three set screws in the side of sector and slip sector over framing cam surface A-7, Fig. 1. It will be found that the hole in this gear sector now fits over the protruding pin left by previously sawing off framing link stud. This sector should be attached with stop pin on the bottom, as shown in Fig. 4.

Press gear sector tightly over framing cam and tighten the three set screws above referred to solidly against framing cam surface. The gear sector will now be rigidly attached to the framing cam. Remove shutter adjusting knob K-120-A, Fig. 1, from mechanism; replace with gear

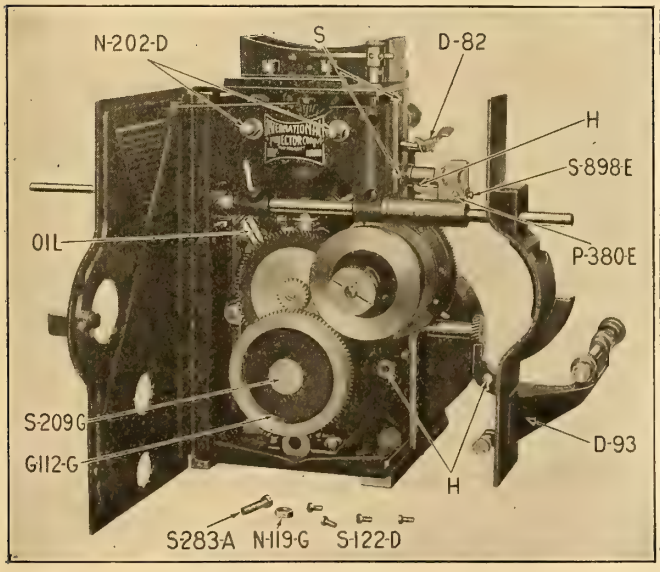


Figure 4

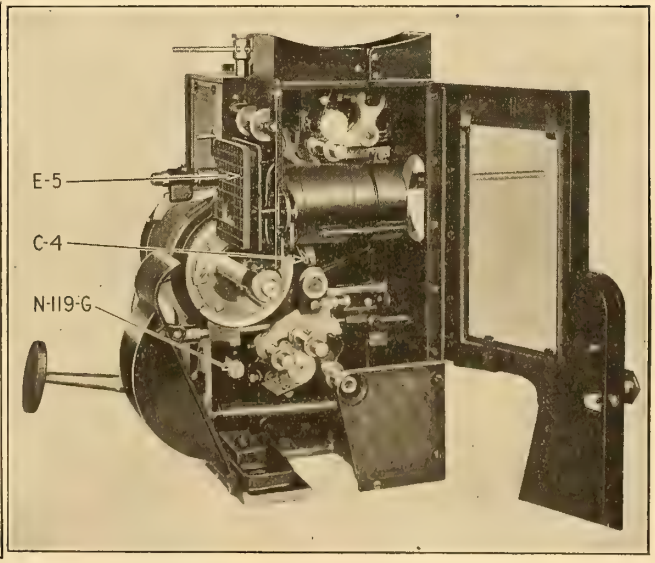


Figure 5

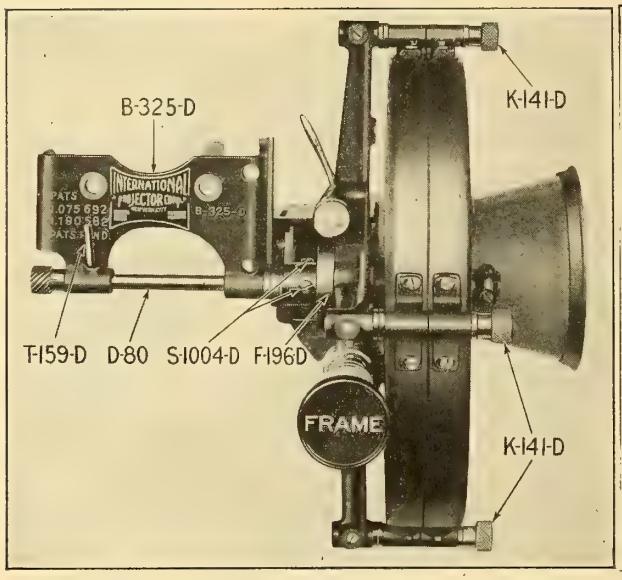


Figure 6

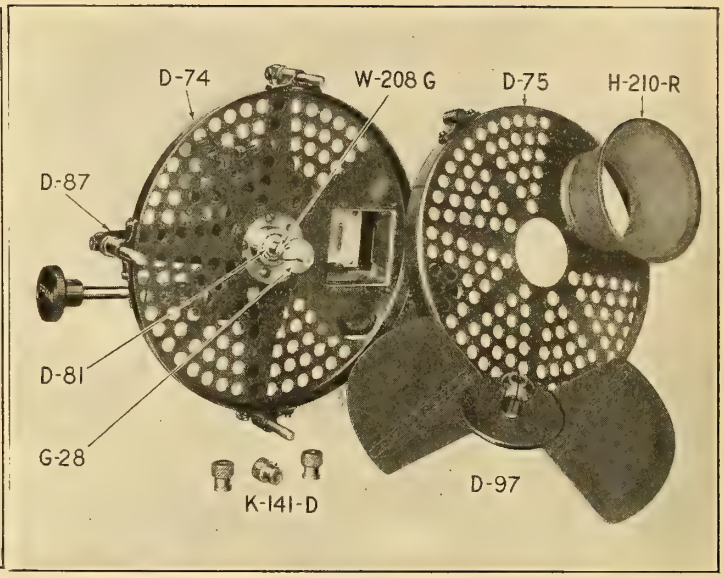


Figure 7

D-94, Fig. 2, found in envelope. Be sure that set screw in gear hub lines up and is inserted rigidly in spot on shaft. Replace mechanism cover P-207-D, Fig. 1, using the screws originally removed. Do not tighten screws solidly, however, until instructions are given later.

Assemble to mechanism new cover assembly D-93, Fig. 2, being sure that shutter adjusting gears mesh properly. Use balance of screws S-122-D (4), shown in Fig. 4, originally removed from old type cover. Now tighten screws, two on top and one in front, rigidly attaching top cover P-207-D, Fig. 1. Replace screw S-181-D, Fig. 1, through door opening link as originally removed. See that door closes and opens freely.

Take the screw S-283-A and nut N-119-G, Fig. 4, previously set aside and place the screw through holes shown at H, Fig. 4, and fasten solidly with nut N-119-G on opposite side of frame. This solidly locks cover D-93 to main frame. Replace G-112-G and S-209-G, Fig. 1, being careful that gear properly meshes and slips solidly against driving spindle collar. Reassemble lens focusing knob A-8, Fig. 1, as originally removed.

Set the intermittent oil box so that oil level line is parallel with base of mechanism. This may be done by pulling down or pushing up on gear sector now attached to framing cam. Slip main shutter guard assembly complete with eye shield, framing handle, pilot light, etc., over bearing on B-325-D, Fig. 6, from which it was originally removed, taking care that shutter lift lever D-82, Fig. 4, is lifted so as not to interfere.

Set framing knob so that the word "Frame" reads horizontally, as shown in Fig. 6. Press this assembly back as far as it will go, placing gear and framing gear sector in mesh, allowing a slight clearance between them, and replace the two screws S-1004-D, Fig. 6. Lock these screws tightly. Slip ball bearing D-81, Fig. 7, over shutter spindle, pushing it back into its housing as far as it will go. Replace the four washers W-208-G, Fig. 7, previously removed together with the spacing collar G-28, Fig. 7, over shutter shaft. Remove all end play in shutter shaft by pulling on same and pushing spacing collar back tightly against washers. Lock clamp screw in spacing collar tightly. Attach revolving shutter and set in the usual manner. Replace shutter guard D-75, Fig. 7, and its retaining screws K-141-D, Fig. 7, and the mechanism is now ready to be set on stand and placed in operation.

Be sure to oil thoroughly all working parts before placing in service.

Correct Film Splicing Method

The liability of film to damage makes it essential that splices be made carefully, securely and uniformly. This will aid in keeping prints serviceable and free from defects and in preventing projection troubles in theaters. Poor splicing causes loss of film and may increase the fire hazard during projection. Poor splices include those that are buckled, stiff and out of alignment and those which overlap too much or too little. Any sort of damage to film must be repaired as soon as it is observed.

Film Splicers should *always* be used, for making film splices. Film may become stiff or may buckle through excessive scraping or too liberal application of cement, or both. To make a perfect splice, the emulsion must be thoroughly scraped on the sprocket hole edges as well as the remaining surface, otherwise splice will pull apart. Reels must be spliced from tail to head so that when the film is placed in the projection machine it will not catch. Scraping is done to remove the emulsion and properly to prepare the film to receive the cement, therefore it is necessary to scrape evenly and smoothly.

Sound Film Splices

Splices on sound track film must be painted in a triangular shape, on the *celluloid* side of the sound track, using black lacquer and an artist's small paint brush. Two sprocket holes on each side of the splice are considered the base of the triangle, the apex being the center of the splice.

Extreme care must be taken to insure that the outside of the triangle on both sides is smooth and gradually brought to the center.

The lacquer painting eliminates the "boom" sound which is caused by an extra layer of film being spliced over the original sound track, giving it extra density. If smoothly done, the painting will prevent distortion and the sound will gradually fade in and out.

Extreme care must be exercised to insure that all splices are made "in frame." A splice made out of frame is one having more or less than four sprocket holes to the frame or more or less than 16 frames to the foot.

Ad Sign—With Sound

What is probably the first talking sign of its kind ever erected has been installed on the Coney Island boardwalk by the Brooklyn Paramount. It measures 180 feet in length by 28 feet in height and stands 75 feet from the ground. The sign will be in operation for several hours every afternoon and evening during the summer season. Loud speakers are used with announcers and will be supervised from a house in the rear. Announcements can be heard for a half mile and the sign can be seen for at least three-quarters of a mile.

Wide Film vs. Wide Image on Standard Film

By JAMES J. FINN

GRANDEUR must not be adopted by the motion picture industry! Thus the decision reported to have been reached at a recent conference of leading producers and exhibitors who, alarmed at the advance cost analysis of a new wide film system, have banded together to resist the introduction of wide film on any other basis than as an attachment to present equipments. Grandeur or any other wide film system necessitating the purchase, installation and operation of wholly new equipment, in addition to requiring a radical change in production and reproduction standards, must not be, simply cannot be—according to the idea of the aforementioned executives.

When a process can be found which will give a satisfactory wide film image with standard reproducing equipment, why should anyone go to the great expense of buying all new equipment for his theatre? This is the argument advanced by the industry's leaders, an argument which has launched an intensive worldwide search for a process with which results can be had—and cheaply.

All this activity has resulted in the development of a number of processes which are regarded as possible answers to this mooted question. It is of interest, therefore, to look into the merits of the best of these developments and endeavor to ascertain just how firm is the foundation on which such weighty hopes rest.

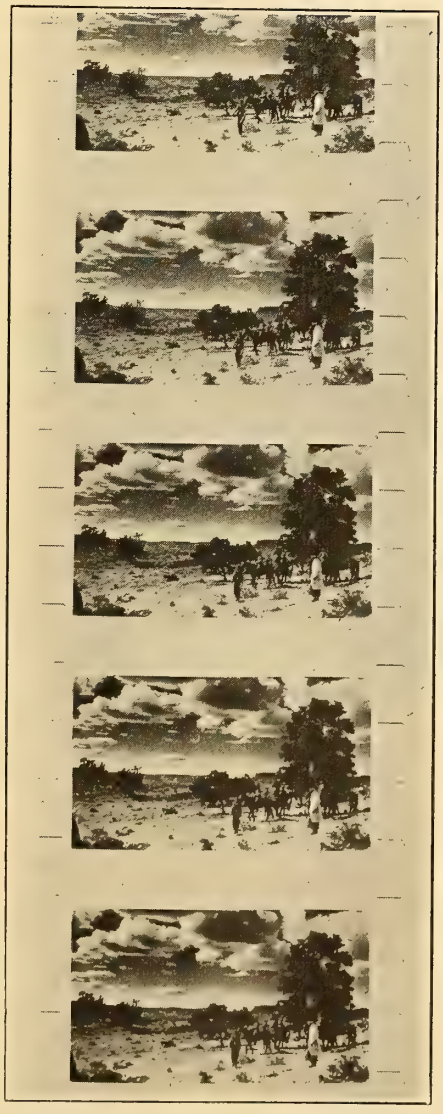
The Fear Process

Many readers of this publication will recall the article by Captain Fear, "Wide Image on Standard Film," which appeared herein recently.[1] This article advanced the cause of "shooting" the film horizontally on standard film, thus securing proper proportionate height and width, while in reproduction the film would run past the aperture horizontally instead of following the present vertical path. Nothing further having been done with this process, it is assumed that the idea has been discarded. However, this system was easily the most promising of the many submitted to actual tests.

And now we come to a system which is understood to have the endorsement of a leading producer, distributor, and exhibitor organization as the answer to the problem of a wide image on standard film—the process upon which high hopes have been placed and upon which development work has been progressing for the past several weeks both on the West Coast and in New York City at a Broadway theatre. The proponents of this system hold it in such high esteem that they scoff at the idea of introducing Grandeur, Spoor Berggren, or any other "regular" wide film process. However, their reluctance to disclose the details of this new and "revolutionary" system piques the curiosity of the technically-minded and prompts a delving into the meager bit of information available on the process in the hope of uncovering some facts which would justify the bullish attitude of its sponsors.

Reduction in Printing

The conclusions reached after due deliberation of the problem are set down in subsequent paragraphs, and the reader may draw his own deductions therefrom.



Greatly enlarged reproduction of wide image on standard film. Note spacing between frames

This new process involves the "shooting" of a picture on 70 mm. film and its subsequent reduction during the printing operation to standard 35 mm. proportions. Projection of the image is then achieved by means of a special three-combination lens of extremely short focal length. Special high intensity lamps drawing 160 amperes are employed for purposes of illumination. This and no more information is available at present.

In the accompanying illustration is reproduced a strip of film produced with this process. Examination of this strip reveals that insofar as proportionate dimensions are concerned the effort is a success—but how about the quality of the picture? It will be noted that there is quite a bit of space between film frames, the answer to which is that in order to secure width provision must also be made for height. But since height is not desired, the proportions of the image must be maintained in another fashion —thus the spacing between images.

To our mind this blank space is the first indication that the process tends toward the makeshift, despite the fact that the blank space may be comfortably taken care of in projection by a special masking arrangement.

Printing Difficulties

To begin at the beginning, it is obvious that even with a perfect negative it would be next to impossible to transmit every detail of the picture to a positive film one-half the size. Let us assume the presence of a thin line on a wide film; what would this line look like if reduced by one-half? It probably wouldn't show up at all—which suggests that this new process lacks sufficient definition even in the positive print. Graininess in film is the problem in the production end.

It will be noted that the accompanying film strip has no sound track, which suggests the use of separate sound equipment or the further reduction of the present image by at least 100 mils, or more, to accommodate the track, with a consequent further proportionate reduction in size as a result. The resultant image would approximate 16 mm. film in size more closely than it would 35 mm.

Optical Problems

When one pauses to consider the tremendous magnification required to secure a picture of, say, 45 feet, one is impressed by the extremely difficult optical problems involved. Just what is this "special three-combination lens" is not quite evident at the

[1] Sept., 1929, Vol. 2, No. 11.

moment, but it undoubtedly is a lens of extremely short focal length. As the well-informed know, short focal length lenses are notably inefficient because of the tremendous curves the manufacturers have to get into them. When drawing 160 amperes, as is planned, and having to secure an intense concentration of light on a relatively small aperture, as seems probable, it becomes increasingly difficult to secure ample illumination without encountering considerable trouble as a result of light losses and enormous heat generation.

If the proposition is simply one of magnification of a small image to get a doubly large image, why not Magnascope as employed in many Publix houses by Harry Rubin?

Further, the New York theatre which is now being used for development work on this process is far from the ideal of a regular motion picture theatre. It is a former legitimate theatre which has been converted for motion pictures, and it is doubtful that the image being shown therein during the tests approximates even closely the proportions of a 45-foot picture, which is regarded as the probable average size picture for wide film presentations.

With these considerations in mind it appears a bit rash for anyone to advance the opinion that results comparable with the use of wide film may be had from the use of standard size. The writer is able to state definitely, on the word of a leading executive in the industry, a man who certainly is in a position to know and who by virtue of his long association with the technical end of the business is particularly qualified to discuss the possible introduction of a substitute process for wide film, that development work on Grandeur is going ahead at top speed and that installation of the apparati in one of the leading theatre chains in the country will be started early next winter.

Both Sizes on Grandeur

The new Grandeur projector will be able to project both 35- and 70-mm. film with only a slight adjustment. The first models accommodated only the larger size.

Improved Grandeur

It is interesting to note that the forthcoming Grandeur equipment will be radically different from that which was used in recent demonstrations on the West Coast and in New York. It is understood that the entire Grandeur projector equipment has been completely re-designed, a work which has occupied more than a score of draftsmen and technicians for the past several months. The new Grandeur equipment will be radically different from the pioneer outfits, and sponsors of the system state that the finished product will surpass all expectations for sturdiness, stability and performance.

It is not expected that the tests on a wide image on standard film now in progress in New York will be completed for several weeks yet, but complete data thereon will appear in these columns as soon as it becomes available.

An All-Purpose Testing Set

By Engineering Dept., Weston Electrical Instrument Corp.

SINCE the advent of synchronized sound with the motion picture, new problems confront the projectionist. Chief among these is the proper operation and maintenance of the electrical equipment. One of the necessary means of securing proper operation and maintenance of the electrical equipment is through the use of electrical measuring instruments. These are indicators of the electrical quantities. The ideal condition is to embody the electrical measuring instruments as parts of the electrical circuit which makes it possible at any time to quickly observe the electrical condition of the circuit. Such instruments would comprise direct and alternating current ammeters and voltmeters for the measurement of filament currents or voltages as found in circuits employing vacuum tubes. Such instruments are shown in Figs. 1 and 2.

Direct current milliammeters and voltmeters similar to Fig. 1 are used to measure plate current and voltage and are proper whether the source is storage batteries or rectified A. C.

Instruments similar to Fig. 1 are also employed to measure grid current or voltage, cathode voltage, screen voltage and current when screen grid A. C. or D. C. tubes are used. Line voltage and current may be shown by an instrument similar to Fig. 2 when A. C. is employed or one similar to Fig. 1 when D. C. is employed.

Space Considerations

Quite a number of measurements may be made to secure proper operation of the equipment for synchronized sound pictures, but to incorporate these instruments into the electrical circuits may not always be possible due to lack of space and financial reasons. However, the need for such electrical measurements is essential and in order to meet this condition a composite instrument termed a service test set may be used to advantage. Such a test set is shown in Fig. 3. Certain requisites are desirable in a test set among which are compactness, reliability, accuracy, completeness, and ease of operation. By compactness is meant the possibility of being carried about from place to place in order to service equipment at several localities.

The indications of the service test set should be accurate not only from day to day but over longer periods of time reaching into years in order to get a fair return on the investment.

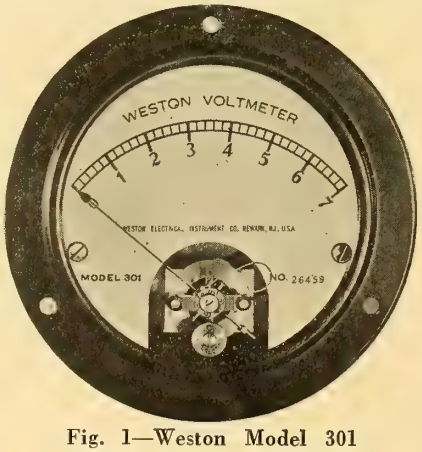


Fig. 1—Weston Model 301
Actual size 3¼" diameter

The test set must be complete and easy to operate. By complete is meant that it must provide means of making as many of the necessary measurements as possible and that it must be a service instrument and not a laboratory model. To show the scope of this type of equipment the Weston test set shown in Fig. 3 is described in the following paragraphs:

Components of Test Set

Instruments and Switches. The test set has three instruments, a D.C. milliammeter, a D.C. volt-milliammeter and an A.C. Voltmeter, and is provided with various switches, plugs and cords for properly connecting the instruments to the circuits under test.

A.C. Voltmeter. This instrument has 5 ranges, 750/150/16/8/4 volts. Any of the three lower ranges can be connected directly across the filament terminals of the tester plug by setting the A.C. selector switch to the desired range. These ranges are for the purpose of measuring the filament or heater voltages of tubes whose filaments are heated with unrectified alternating current, commonly called raw A.C. The 150-volt range is provided for the purpose of measuring the line voltage and the 750 range for measuring voltage of transformer secondaries. These two ranges are available only at the binding posts marked (750), (150) and (plus or minus). The ranges 150 and 750

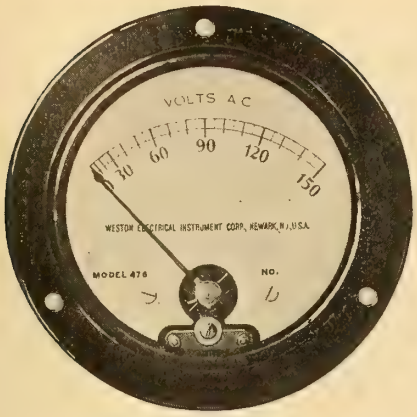


Fig. 2—Weston Model 476. Actual size 4⅜" diameter

volts are electrically insulated from the lower ranges.

The low ranges are also available at binding posts marked (16), (8), (4) and (plus or minus).

D.C. Volt-Milliammeter. This instrument has 8 ranges, 750/250/100/-50/10/5 volts and 100/2.5 milliamperes. The 750 and 250 ranges are for plate (B) voltage measurements; the 100, 50 and 5 are for grid bias readings; the 50 range is also used for cathode voltage readings; the 10-volt range is for filament voltage readings and the 5-volt range is also used for continuity tests. The 2.5 milliampere range is for use in measuring screen current of screen grid tubes and the 100 milliampere range for measuring plate current of rectifier tubes. All voltage ranges are available at the binding posts.

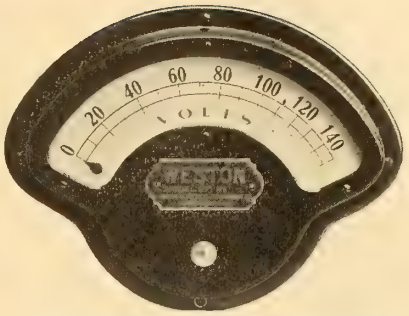
D.C. Milliammeter. This instrument has two ranges, 100 and 20 milliamperes. Either range as desired may be used by throwing the MA. toggle switch to 100 MA., or 20 MA. These two ranges are also brought out to binding posts. Shunts can be obtained to increase the range of the milliammeter to 2 or 10 amperes. The 2-ampere range is for measuring current in dynamic speaker field coils, trickle chargers, etc., and the 10-ampere range for measuring larger currents such as charging range of 5 or 7.5 ampere chargers, etc.

Dial Switches. Two bi-polar switches are provided to connect the D.C. Volt-Milliammeter to the various circuits as designated on the dials. They are arranged in such manner that the instrument can not be connected across any two circuits at the same time. For all readings on dial No. 2, dial No. 1 must be set to position (switch No. 2). A smaller switch is provided marked (4), (8), (16) and (OFF) for use in selecting the desired A.C. filament voltage ranges for connecting the A.C. Voltmeter directly across the filament terminals.

Binding Posts. All ranges of the three instruments, except the 100 and 2.5 milliampere ranges of the volt-milliammeter are brought out to binding posts for making voltage or current measurements directly on batteries, rectified power devices, continuity tests or for any purpose for which the cord and tester plug is not adapted.

Tests Possible with Set

When testing sets having tubes operated with raw A.C. the A.C. Voltmeter may be left in circuit during the tests for plate voltage, plate current, C bias voltage and tube tests described later. This allows the operator to follow any changes which may occur during tests due to variations in filament voltage. The 750 and 150 volt ranges of the A.C. Voltmeter are entirely insulated from the low ranges and all other circuits in the test set, therefore, while only one range can be used at a time to obtain correct readings, no damage can result if high and low ranges are connected simultaneously and either of the high voltage ranges may remain in circuit during any of the other tests.



Weston Model 271. Actual size 5½" wide

The low range binding posts for A.C. voltages must not be used when the tester plug is inserted in the set because of possible interconnections.

The A.C. Voltmeter switch should be placed in the (OFF) position when testing D.C. type tubes with the D.C. Voltmeter and its associated bi-polar switches. No harm will result, however, if the A.C. meter is left in circuit while making D.C. measurements, but because the A.C. Voltmeter takes more current for its operation slightly inaccurate readings may result.

CAUTION:—The tester plug should be removed from the set when the binding posts are used because of possible interconnections in the set.

Resistance Measurements. Resistance from 100 to 100,000 ohms may easily be measured without additional equipment, by setting dial-switches to "Cont. Test" and connecting the unknown resistance to the binding posts marked "Cont. Test" and comparing the deflection of the center instrument with chart, which is included in the Instruction Book, furnished with each set.

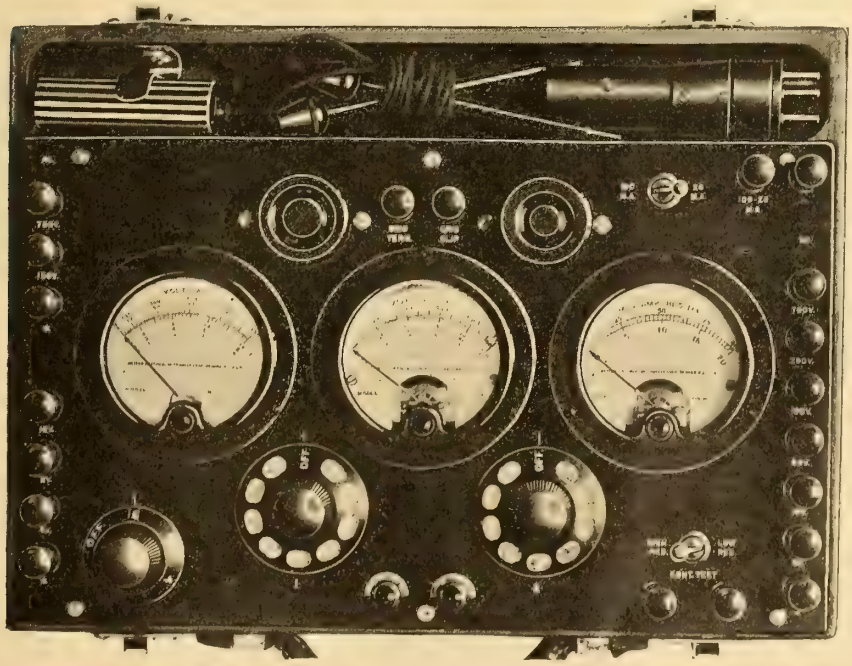


Fig. 3—Weston portable set tester model 547

Following Tests Are Made with Tester Plug in Set Socket and Tube in Tester Socket

D.C. Filament Voltage. Set dial No. 1 to (A) or (A rev.) to obtain an up scale deflection. See that A.C. selector switch is on the (OFF) position. Read directly on the 10 volt D.C. scale.

A.C. Filament Voltage. Set A.C. selector switch to desired range and read directly on the A.C. Voltmeter.

Plate Voltage. Set dial No. 1 to (B 750) or (B 250) and read directly on D.C. Voltmeter.

C. Bias Voltage. Set dial No. 1 to (Neg. C-100) or (Neg. C-250) and read the 50 volt range directly on the 50 volt scale of the D.C. Voltmeter; for 100 volt range read on the 10 volt scale and multiply by 10.

If, when measuring the filament voltage of D.C. operated sets, the voltmeter indicates up scale with dial No. 1 at (A-Rev.) the C bias measurement should be made with dial No. 2

at (C—50 A Rev.), dial No. 1 being first set to (switch No. 2), read directly on the 50 volt scale.

Screen Grid Voltage. Connect short lead with clip, between binding post marked (Grid Term.) and tip of tube—connect long lead with clip between binding post marked (Grid Clip) and grid clip in set—turn dial No. 1 to (Pos. C—250) or (Pos. C—50) then read direct on the 50 scale of the D.C. Voltmeter, or for the 250 volt range read on the 250 volt scale.

Screen Grid Current. Set dial No. 1 to (switch No. 2) and turn dial No. 2 (Screen Current 2.5 MA.), then read current on 250 range of the center instrument and divide by 100.

Cathode Voltage. Set dial No. 1 to (switch No. 2)—set dial No. 2 to (K Neg.—50) or (K Pos.—50) whichever gives an up scale deflection, then read direct on the 50 volt scale of the center instrument.

Control Screen Grid Voltage. Connect short lead with clip between binding post marked (Grid Term.) and tip of tube—connect long lead with clip between binding post marked (Grid Clip) and grid clip in set—turn dial No. 1 to (switch No. 2), then turn dial No. 2 to (Cont. Grid—10) or (Cont. Grid +100). If the tube is being used as a screen grid amplifier the voltmeter will give an up scale deflection on the (Cont. Grid —10) setting—if the tube is being used as a Space Charge amplifier, the voltmeter will give an up scale deflection on the (Control Grid +100) setting.

Plate Current. Set the MA. toggle switch to 100 MA. or 20 MA. depending upon the range desired, and read the plate current directly on the D.C. M.A., which is connected in the plate circuit at all times.

Grid Current (Other Than Screen Grid Tubes). If grid current is present in amplifier tubes, it will be indicated by a deflection to the left of zero on the center meter, when switches are set for screen grid current. If any grid current is present it may be due to a gaseous tube, oscillating or unbalanced circuits.

Grid Test. First note the reading on the D.C. Milliammeter, then depress push button (Press for Grid Test). An increase in plate current will result because the C bias is decreased by 4.5 volts (the voltage of the small contained dry battery). The amount of increase in plate current is a measure of the condition of the tube.

Grid Test for Screen Grid Tubes.

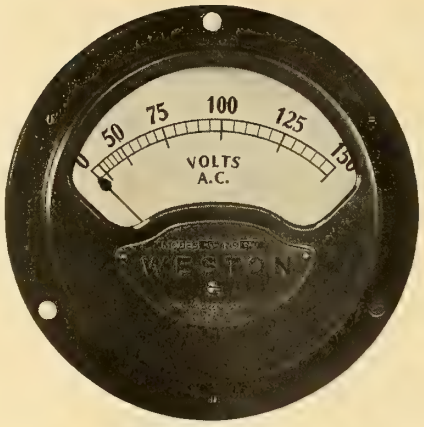


Fig. 4—Weston Model 429. Actual size 3¼" diameter

First measure the control grid voltage by setting dial No. 1 to (switch No. 2) then set dial No. 2 to (Cont. Grid —10). Return dials to (OFF) position before pressing buttons as outlined below.

CAUTION:—If at this position the voltmeter tends to read backwards, it indicates the tube is being used as a Space Charge Amplifier. In this event the push button (Press for Grid Test) should be used instead of (Grid Test on S.G. Tubes), if the voltmeter gives an up scale deflection, the push button (Grid test on S.G. Tubes) should be used. An increase in plate current will result, due to the change in bias voltage from normal to zero bias. Always determine which way the tube is being used before making the grid test. As stated previously, if the tube is being used as a screen grid amplifier, the voltmeter will give an up scale deflection when dial No. 2 is set at (Cont. Grid —10), and if it is being used as a Space Charge Amplifier, the voltmeter will read in the proper direction when the dial is set at (Cont. Grid +100).

Testing Rectifier Tubes. All rectifier tubes of filament type may be tested. Set dial No. 1 to (switch No. 2) and turn dial No. 2 to (Rect. Tube + 100 MA.), also set milliammeter toggle switch to (100 MA.), then insert tester plug in rectifier socket and place tube in test set. If the tube is the '81 type (half wave) the milliammeter will indicate the total plate current,— if the tube is a (full wave) rectifier such as the '80 type, the milliammeter will indicate the plate current in one plate and the center instrument will indicate the current in the other plate. This gives the current in both plates simultaneously and should be added to get total current. Both instruments should read the same. If they do not, it is an indication that the emission of one filament is lower than the other.

CAUTION:—Do not insert tester plug in rectifier socket until the dial switches are at the proper positions. DO NOT PRESS EITHER PUSH BUTTON. Filament voltage may be measured in the same manner as for any other type of tube.

Testing Batteries, Eliminators, Power Packs, Etc. First make sure that the tester plug is not in any socket of the set. Set dial No. 1 to (Switch No. 2) and set dial No. 2 to (Vm. B.P.). The two flexible leads with test prods should then be connected to the D.C. Voltmeter binding posts (black to minus and red to range desired). The instrument can now be used as a multi-range voltmeter to measure the voltage in any circuit or any of its parts. The test leads may also be connected to the A.C. Binding Posts and the line voltage, high and low voltage of power transformers, etc., can be measured.

Continuity Tests. Set dial No. 1 to (Switch No. 2)—set dial No. 2 to (Cont. Test) and attach the two test leads to the two binding posts marked (Cont. Test). (The voltage of the contained battery may now be checked by touching the two leads together—the voltmeter should read 4.5 volts which is read on the 50 volt scale divided by 10). The two leads are then connected to the part of apparatus in which continuity of circuit is to be checked. Note the indication on the D.C. Voltmeter using the 10 volt scale, the reading can be compared with the chart in the Instruction Book which shows the resistance of circuit directly. If the resistance of the circuit is below 5,000 ohms the toggle switch (High Res. —Low Res.) should be thrown to (Low Res.) and for the resistance higher than 5,000 ohms, toggle switch should be thrown to (High Res.). When set to (High Res.) position, the voltmeter has a resistance of 1,000 ohms per volt and on the (Low Res.) position, the voltmeter has a resistance of 100 ohms per volt.

CAUTION:—When making continuity tests be sure that all power is disconnected from apparatus under test.

Table A appended shows a sample set of readings obtained from an audio frequency amplifier as used for sound pictures.

Type Tube	Position Of Tube	"A" Volts	"B" Volts	"C" Volts	Normal MA.	Grid Test	Cathode Volts
'27	1st Audio	2.3	50	2	2	2.5	+3
'27	2nd Audio	2.3	125	5	5.4	6.5	+8.5
'45	P.P. "	2.48	183	38	32	37	——
'45	P.P. "	2.48	183	38	33	37	——
'80	Rect.	5	——		37		

Line Voltage—115 Volts.

Table A

Everyday Science

Chart Nerve Reaction by Means of Electricity

REMARKABLE experiments on the nerve of hearing, indicating that this nerve operates in a way quite different from the nerve of the eye and presumably of other nerves in the body, have been reported to the National Academy of Sciences, in Washington, by Mr. Ernest Glen Wever and Mr. Charles W. Bray, of the Department of Psychology of Princeton University.

Operating surgically on anesthetized cats, these experimenters connected the nerve of the ear electrically to an amplifier like those used in radio. Electric impulses coming over this nerve, instead of reaching the animal's brain, then were sidetracked into the amplifier, magnified millions of times and could be recorded on electric meters or fed into loudspeakers so that sounds corresponding to these nerve impulses were heard by the human observers.

Previous similar experiments on eye nerves and other nerves, chiefly by the late Dr. E. D. Adrian in England, had disclosed electric nerve impulses differing greatly in character from the impulses of light or other impulses received. Contrary to this, Mr. Wever and Mr. Bray find that the electric impulses in the ear nerve are precisely like the sounds entering the ear.

World's First All-Radio Train Novel Experiment

The most extensive experiment ever made in the use of radio on railway trains is being carried out this month aboard the "Red Special," a train of all-Pullman, all-compartment cars on which nearly 200 delegates and guests to the annual convention of the National Electric Light Association in San Francisco are making a 33-day trip around the continent.

When this special train left New York City on May 31, 100 radio loudspeakers were at work, one installed in each compartment and drawing room on the train and one or more in each room of the club cars, observation cars and other public parts of the train. New radio devices worked out by engineers of the R. C. A.-Victor Company will keep the loudness and quality of the reception constant no matter how many individual loudspeakers are in use and how many are turned off. A special antenna on the roof of the baggage car will receive programs from every part of the United States, it is expected, no matter where the train may be.

The extent to which passengers on the trip use the loudspeakers in their staterooms, and especially whether this average use increases or decreases as the trip goes on, will constitute, it is expected, an interesting psychological experiment on the value of such entertainment on long railway journeys.

Hopes That Deaf People May Hear by Electricity

A possibility of helping some kinds of deaf people to hear electrically, by feeding suitable electric currents directly into the nervous machinery of the ear without using the ordinary hearing mechanism at all, are being urged in Austria by Professor Stephan Jellinek and Dr. T. Scheiber, of the University of Vienna. In the ordinary process of hearing the sound waves that enter the outer ear are transmitted through the ear drum, the chain of small bones in the middle ear and thence to a liquid inside the inner ear, in which liquid is coiled a nervous membrane containing thousands of separate nerve endings. The vibration of this membrance by the sound waves is believed to be the cause of the nerve sensations recognized as heard sounds.

Employ Electrical Means

Since nerve action of all kind is electrical and since modern vacuum tube apparatus can produce electric currents corresponding exactly to the vibrations of sound waves, it ought to be possible, Professor Jellinek and Dr. Scheiber argue, to pass suitable electric currents into the human ear and thus to set up in the nerve of hearing impulses just like those which are produced when hearing takes place in the usual way.

Preliminary experiments are reported to have been successful and are being continued. The method is not expected to be useful in the kinds of deafness due to deterioration of the nerve of hearing but may help, the Vienna experts hope, in other kinds of deafness in which the nerve itself is not damaged.

Theorize on Harnessing Power of Solar Planets

Sir Arthur S. Eddington, British astronomer, has unfolded another dream before the world power conference at Berlin. This referred to the possibility of utilizing unmeasurable power of planets, or stars and other elements to man's uses.

"We look into the sky and our telescope shows 1,000,000,000 stars," he says, "each of which is a celestial furnace apparently defying the law which limits our terrestial undertakings. In other words, it defies the law that if you do not replenish your furnace it will die out."

However, the bodies of space do not seem to die out. He said the sun, for example, had enough energy to last another 15,000,000,000 years.

Eddington explained he believed vast stores of untapped celestial power existed, and asserted their existence was proved in the form of rays far more powerful than the ordinary X-rays. These, he said, were the X-rays, which were constantly interfering with the experiments of physicists.

N. Y. Biggest 'Phone User

The New York City Metropolitan area contains a population of approximately 10,000,000 people. Out of this area each day an average of 35,000 long distance telephone calls are sent to all parts of the United States, Canada, Cuba, Mexico and fourteen European countries. In 1927 the average number of calls daily was 25,000. During the summer of 1928, the average number of daily calls reached 38,000 for a considerable period of time. It is estimated that by 1930 the average number of long distance calls will be in the vicinity of 50,000 a day.

Test Proves Astrologers to Be 90 Per Cent Wrong

How little six separate astrologers agreed in reading the character and predicting the future of the same individual who sent his birth date to all six of them independently is reported by Dr. Walter Franklin Prince, research officer of the Boston Society for Psychic Research in a recent bulletin of that organization. A gentleman of Dr. Prince's acquaintance agreed, the latter reports, to write to the six astrologers, whose names and addresses were obtained from advertisements, sending the necessary fees, giving the year, day and minute of birth and asking certain questions about business and other matters.

All six astrologers replied but the difference in their readings, Dr. Prince reports, was ridiculously wide. There even were disagreements about the astrologic "sign" under which the inquirer was born although identical birth data were supplied to all. Statements about health and disease were totally different. Business advice and predictions were similarly unlike.

Although the inquirer was married he included in his inquiry, at Dr. Prince's suggestion, the query "Shall I marry this year?" The resulting advice from the astrologers was as

variable as usual, not one of them having been informed by his stars of the important fact that the inquirer was married already and ought not to be contemplating bigamy. In specification of elements of character, the report summarizes, the astrologers' statements were about half right and half wrong. In social, matrimonial and business matters the astrologers guessed 90 per cent wrong.

Compete With Nature in Manufacture of Pearls

Man, with the aid of gas, has entered into competition with nature in the production of pearls and actually seems to have the advantage. A company in Brooklyn not only makes perfect imitations of genuine pearls, but goes further and turns out tints that nature has never known—to suit any costume or fancy. The pearls are comparable in beauty, ornamental value and appearance to those from the laboratories of the sea. In fact, the firm places strings of the genuine in exhibits of its own product and challenges anyone to select them by ordinary inspection.

The manufacturers have borrowed from nature to compete with her. When the beads have been shaped from special opalescent glass they are dipped in a lacquer of "pearl essence" made from iridescent fish scales. Several dippings, each of a slightly different tint, and the manufactured pearls gleam with the colors of the natural gems they represent.

Uniform heat is a vital factor in this delicate work, and the plant operators have found that gas furnaces vary scarcely a degree in temperature in a day.

To Sleep "Like a Log" Proven to Be a Myth

To sleep "like a log" is an ideal of literature, not of nature. At the Mellon Institute in Pittsburgh Dr. H. M. Johnson and his associates have been studying the movements and postures of normal sleeping individuals by a special motion picture camera which photographs the sleeper every time that he stirs. In a recent report to the American Medical Association, Dr. Johnson, Dr. T. H. Swan and Mr. G. E. Weigand describe one normal individual thus found to twist and turn every few minutes all night long, assuming one after the other no less than 33 widely different postures.

Contorted Sleeping Positions

Thousands of other tests, the investigators report, have shown this almost continual twisting and turning during sleep to be the rule rather than the exception. Only persons who have been heavily drugged lie perfectly quiet when soundly asleep. What is still more remarkable, the majority of the postures assumed in bed by a normal sleeper are shown by the tell-tale camera to be contorted postures, with the body bent or contracted and the spinal column bowed and twisted, as different as possible from the usual medical advice to lie straight and relax perfectly.

Apparently, the Pittsburgh investigators report, "the most restful night's sleep is characterized by the use of a considerable variety of bodily positions, all of which are contorted; none of which indicate anything like 'complete relaxation' of all parts of the skeletal muscular system, such as one may observe in a fainting person; but each of which appears to be well adapted to the relief of irritation that was set up in the posture last taken, as well as in the day's activities."

A New Control Element In Vacuum Tube

A ROTATING grid or control element, which provides the vacuum tube with the additional factor of time, has been introduced. The control element in the new tube is rotated by means of electrons striking the vanes of the rotor. The source of the electrons is the 27-type cathode. The rotating element, in the form of a cylinder with slits and angular vanes surrounds the cathode, and in turn is surrounded by the plate. It has been found that the speed can be varied by changing the grid voltage and increasing the cathode temperature.

From tests it appears that by redesigning the electron motor tube it can be made into a synchronous electron motor, designed to run at various speeds. The general scheme of such an application is to separate the plate into sections, and arrange the vanes so as to correspond to the sections of the plate.

Hence if an alternating current is supplied between filament and plate, the rotor will be held in synchronism when the speed is such that each vane moves one section in one cycle. It is also possible to drive the rotor by a synchronous motor similar to that employed in electric clocks. By dividing the vanes and providing separate plates for the top and bottom vanes, an alternating current can be generated, or one frequency changed to another.

Various commutating and switching actions can be accomplished without sparking and variable contact resistance. The shape of the AC wave can be controlled. The electron motor can be applied to drive a small clock or meter mechanism, all of which may be placed in the bulb. In television it is possible to place all the mechanism inside a small glass bulb.

Continue Spoor Experiments

Radio Pictures will continue experiments begun last year with the Spoor-Berggren wide film process.

The experiments are being conducted to substantiate the opinion that the great future for wide film is in the shooting of outdoor spectacles. Previous experiments conducted with the Spoor-Berggren system were confined to indoor sets. Now Radio Pictures has Spoor and Berggren, in conjunction with Karl Struss, cinematographer, who is photographing "The Record Run," on location in Montana and other points in the Northwest where the wide film process will receive its severest tests on the scenic marvels of that great country.

Indoor "Shots" Until Now

Exhibited last year in New York, the Spoor-Berggren Radio wide film process aroused praise for the depth illusion it conveyed. The films then shown were all indoor-photographed, with the exception of a series of views of Niagara Falls.



One of the projectionist sessions at the RCA Photophone school

Revolving Lens Wheel Projector

(*Continued from page* 16)

the old Kinemacolor process, it must be understood that the conditions, with a continuous projector producing a dissolving action involving three film frames at all times, are entirely different from the old Kinemacolor conditions, and, therefore, vastly different results are to be expected.

The question of excessive color fringe due to motion has been suggested as a possible serious fault, but an analysis of the intensity of illumination would indicate that color fringing may not be a serious factor. When it is remembered that no shutter is used in the projector it is evident that the maximum light intensity on the screen is probably only slightly in excess of fifty per cent of that required with an intermittent projector. Moreover, since the screen illumination is being supplied from three frames simultaneously, it is apparent that each frame is supplying only its proportion of the total illumination; hence, it would appear that the color fringe, especially on subjects not composed entirely of one of the primary colors, would not be of sufficient intensity to be objectionable. This system of natural color projection has real possibilities, especially in connection with sound-on-film subjects, and we expect shortly to be able to demonstrate its superiority.

Adaptable for All Film Sizes

Continuous projection will be especially helpful in connection with the presentation of sound-on-film subjects. This is apparent when one recalls that the film strip must move across the aperture plate at a uniform linear velocity to satisfy the requirements for steadiness in the projected image. Since this is true, there is no necessity for a sound pick-up attachment to be used with the projector mechanism. The sound pick-up can be built into the aperture unit of our projector in such a manner as to add no complications to the present extremely simple threading arrangement. No extra sprockets or idlers are required. Moreover, the film-feeding mechanism may be designed so that it will successfully handle a film strip having standard perforations along one edge only, thus providing room on a 35 mm. width strip for the standard silent film frame and a sound track at least fifty per cent wider than is now used on 35 mm. film. Thus, an opportunity is offered to restore the old silent picture proportions and provide an improved sound track without departing from the standard 35 mm. width.

The usefulness of the revolving lens wheel projector is not confined to any particular size film frame. A design may be worked out for double-width film or for 16 mm. film and such designs will possess all the advantages enumerated herein. As a matter of fact the system is especially suitable for double-width film because it simplifies the optical problems and, due to its two-to-one advantage in light-transmitting efficiency, eliminates the difficulties experienced in getting sufficient illumination for wide film presentations by the intermittent system.

The story of the usefulness of the revolving lens wheel is not complete without a reference to its application

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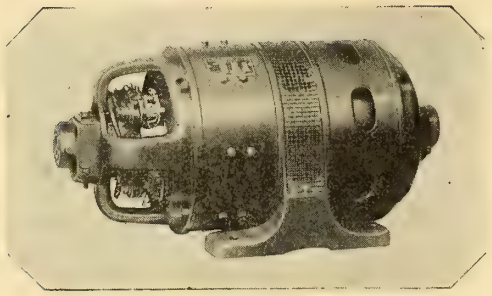
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Revolving Lens Wheel Projector

(Continued from preceding page)

to photography. As stated in the introduction, the true appearance of motion cannot be reproduced from a film depicting only fragments of the original movements. Hence, it is logical to believe that action, as recorded by a continuous camera having no shutter effect, may be reproduced in the most realistic manner by a continuous projector using prints from a negative exposed in such a camera. We are now investigating these possibilities.

Discussion:

MR. PALMER: I would like to inquire regarding the stability of the lens setting under operating conditions, that is when it is subjected to temperature variation, vibration, and varying wear.

MR. HOLMAN: With regard to the stability of the system as affected by wear and shock, I can say that this set of lenses was set originally in April, 1927, and has not been shifted since. I have taken the projector to New York on two occasions in the back of my old Buick and brought it here in the same manner. When I tried it out this morning it worked as well as it did in Boston a few days ago. Temperature is not a factor because a lot of glass is exposed to the beam and therefore the lens wheels do not heat up much. This mechanism was built in 1926 and nothing has been done to the bearings since the machine was completed. The wear to date is equivalent to nine months' steady service in the theatre.

MR. EDWARDS: I should like to ask what speed the projector operated at in this demonstration.

MR. HOLMAN: The projection was at the rate of about 80 feet a minute.

MR. DUBRAY: What provision is made for shrinkage accommodation?

MR. HOLMAN: Film shrinkage is a problem in the design of any continuous projector, with which I have dealt at length in the paper. Previous systems have had a real tussle with this problem. In mirror and prism systems it is difficult to deal with, but in the revolving lens wheel system the solution is simple. The lens wheels are not adjustable along the optical axis of the machine. The front element is adjustable axially, as is also the aperture unit. These parts are slidably supported on pins and the two are moved to compensate for film shrinkage. It is a very simple matter to design lever arms having the proper ratio to allow for compensation for film shrinkage. The set-up here does not differ much from what I have had in Boston. The throw is somewhat longer and the pitch angle is greater, but, as regards shrinkage adjustment, there is no difficulty; it merely means taking hold of, and turning a hand adjusting wheel. The operator really doesn't realize what is happening when adjusting for shrinkage; he is changing the position of the front element and the projector aperture plate with respect to the lens wheels. This changes the back focus because the aperture unit moves away

from or toward the revolving lens wheels; however, the corresponding movement of the front objective with respect to the revolving lens wheels also varies the equivalent focal length of the system simultaneously.

MR. SHAPIRO: Has Mr. Holman any figures as to the light efficiency of his projector as compared with the intermittent type with the same source of light?

MR. HOLMAN: I am sorry to say I have never measured the light intensity on the screen. We ran comparison tests a month or so ago with a Simplex equipped with the Ross lens, and the conclusion was reached that there was no difference in screen illumination with the two machines under the same conditions; *i. e.*, equal arc amperage, lens opening, *etc.* These tests were made using a mask such as I have here today. It is possible, however, to put on the screen the light now lost on the two fiber sheets forming the mask, by using an optical economizer, and under these conditions the light transmitting power of the system is about double that of the ordinary intermittent machine.

MR. ROBIN: Is the relative speed of the wheels half the angular velocity the film? What means besides the brake has been provided for wear or backlash in order that the two optical elements will register in optical centers at the same moment on the optical axis?

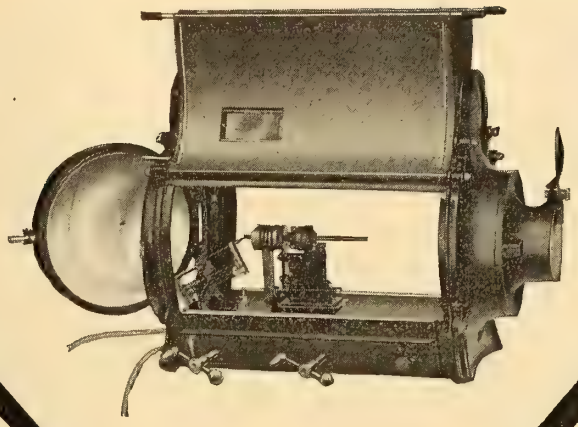
MR. HOLMAN: There is no definite prescribed relation except that one lens sector crosses the optical axis in the time required for one film frame to cross the axis. The relative velocity in this machine can be figured out. The optical diameter on which the lens sector centers are set is 12 inches, and there are 16 lenses on the wheel, so you can figure out the ratio of movement of film and lenses. There is an opinion abroad that the ratio must be one to one—that the lens sector must be the same height as the film frame, but this is incorrect. In regard to wear, it is to be noted that normal wear in gears and bearings is not a serious factor unless it is uneven or excessive in amount, because all parts are operating under a uniform and constant load. The sprocket overcomes a uniform film drag and the lens wheels operate against a uniform brake load.

MR. FINN: I should like to know whether any provision is made for precise adjustment in film splicing.

MR. HOLMAN: There is no precise adjustment required in making film splices. The sprocket actuating the film across the aperture plate is a standard intermittent sprocket and it is positioned 2¼ inches below the optical axis. If the splice is good enough to run over the sprocket, there will be no appreciable jump in the picture.

MR. GOLDEN: Is there any additional time required for re-threading in the case of breakage?

MR. HOLMAN: Threading is about the same as in other machines, but the mechanism is open and large and there is no main shaft in the way, so that there is plenty of room. There is the usual top sprocket feeding the top loop, an aperture unit sprocket, and the bottom or hold-back sprocket.



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Recording Technic for Sound Pictures

(*Continued from page* 27)

ing will realize the discomfort of complying with this rule, because of the natural tendency to twist the dials. Someone has facetiously nicknamed this tendency "mixer's itch." Probably the best way to overcome it is to continue to twist the dials, but limit the amount of twisting to about 3 db. Since 3 db is scarcely noticeable to the ear, it does no damage to the overall artistic result and is therefore permissible. After the mixer has become accustomed to limiting the twisting to 3 db, he can then remember that since 3 db. is hardly noticeable to the ear, this amount of mixing not only does no harm, but also does no good and therefore is unnecessary.

Different Voice Levels

In view of the fact that most of the recording does not require mixer manipulation, it seems unfortunate that it is necessary to appear to lay any stress on the exceptions by enumerating a few. However, it is necessary from certain practical considerations to occasionally control the volume during recording. An instance of this is as follows: when two actors, playing opposite one another, have very different voice intensities, it is legitimate to have one volume setting for the weaker voiced speaker and another for the louder voiced speaker. This technic should only be used when the speakers' voices differ sufficiently, so that they would be unsuitable from the standpoint of the legitimate stage.

A second example would be the case of very soft dialogue of long duration occurring within a scene. It is then advisable to raise the level of this slightly, to avoid the danger of it being interfered with by surface noise after the prints become old. Other similar situations would naturally be handled in a similar manner. This rule might be restated as: Never touch the mixer dials during a take unless there is an important artistic reason for the resulting unnaturalness.

Scoring Procedure

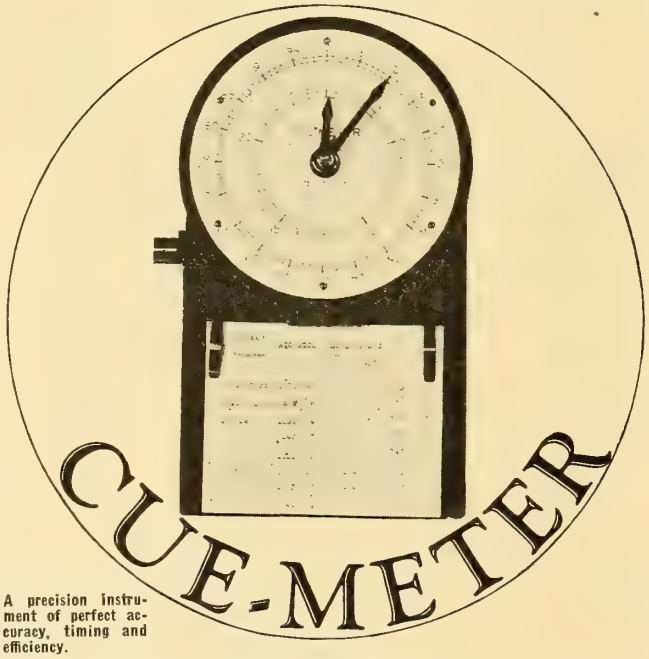
The final matter is scoring. Scoring is normally divided into two parts, pre-scoring and post-scoring. Pre-scoring refers to the condition where the sound record is made first, and the scene photographed synchronously with the playing of this record. The acoustics of pre-scoring should be designed to fit the acoustics that would be expected in the scene which is to be depicted with the sound record, and therefore each case is a problem of its own. However, the principles governing the acoustics for this type of scoring are similar to those for sets.

In general, prescoring is best limited in incidental music, music for dancing, marching or for other off stage sounds. It is difficult to prescore a song in which the singer appears in a close-up or semi-close-up in the picture, since it has been found that the singer pays more attention to keeping in synchronism with the record than to acting. It is, therefore, preferable under these conditions to make a direct synchronous take.

Post-scoring is the addition of music and occasionally dialogue to a scene which has already been photographed. The greater part of post-scoring is done in a room or studio known as a scoring stage, the acoustics of which can be adapted to the requirements of this type of work. The two important acoustic factors controlling such a stage are first, its time reverberation, and second, the distribution of sound absorbing, and sound reflecting material within it. It is well known that for two ear listening, the time of reverberation of a room for music depends upon the size of the room. This is also true for one ear listening or recording, with the difference that the numerical value of the time is less than for two ear listening.

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Positioning Orchestras

There are probably many arrangements of the orchestra players, which will give highly satisfactory results. Considerable experience has failed to disclose an arrangement which is superior to the natural arrangement which the musical director would choose, were he giving a concert in a small auditorium. In view of the fact that it is often necessary to photograph an orchestra while playing, this natural arrangement, which is satisfactory from a visual standpoint, as well as a musical one, seems desirable.

It should also be noted that with such a natural arrangement, no special experience is required on the part of the musical director. Samples of orchestra recording, made with this type of arrangement, can be listened to by purchasing any of the symphony orchestra records made in this country by the Victor Talking Machine Company, and issued since the summer of 1927.

In scoring, as in ordinary dialogue recording, the dials should be operated as little as possible during a take. With orchestras of 30 pieces or less, it is scarcely ever necessary to touch the mixer dial during a take. However, with very large orchestras, a loudness range of 50 db is sometimes obtained, and this range is slightly too great to be handled with the present system.

It is, therefore, necessary to do some manipulation. There are two ways this compressing of the range may be handled. The first is to permit the volume to rise fairly close to over-load and then begin cutting down on the volume control to avoid valve clash or the record cutting over. This method is probably the easier one for the untrained mixer, but unfortunately removes a great deal of the "punch" from the big crescendos.

The second method requires some knowledge on the part of the mixer of the music that is to be played. When a crescendo is commencing, the mixer should start reducing the volume slowly before the loudness has approached the danger point, and having lowered it the requisite amount, leave it alone entirely for the remainder of the crescendo. In a similar manner the raising of the level for the very soft parts should also anticipate the actual pianissimo passage.

Dinner for Dempsey

A dinner dance given by friends of General Secretary-Treasurer Fred J. Dempsey of the I. A. will be held in Boston at the Copley Plaza Hotel on Sunday, July 27th. The affair was planned to honor Dempsey for his election to his new I. A. post.

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Hints on Equipment Maintenance

BECAUSE of the rapid advances, amplifiers today are intricate. Consequently, when troubles occur, they require the services of competent trained projectionists and engineers. Good, reliable test equipment is necessary. In almost every projection room, where sound equipment is installed, there will be found a portable direct current voltmeter and ammeter, which is usually found in the ERPI spare parts cabinet.

Any measuring instrument will stand a certain amount of abuse; however, it is advisable to see that they have reasonable care to assure the highest degree of accuracy. No matter what the value of the testing instrument may be, it should always be put away in some location that is free from dust, oil, heat, moisture and excessive vibrations.

Projectionists often leave expensive testing instruments in a rewind bench drawer among other things including tools. A container should be provided for testing instruments, which are not in use. There is positively no excuse for the projectionist or engineer abusing testing instruments.

Storage "B" Batteries

Many of the first Western Electric sound installations are still receiving their plate potential from storage "B" batteries. Storage "B" batteries consist of twenty-four cells.

Each cell delivers a potential of two volts and each group of cells deliver, when fully charged, forty-eight volts. The storage "B" battery often becomes unusable owing to one or more cells becoming defective. In such cases, the defective cell can be shunted out by connecting together the two cells on either side of the defective one. This method, of course, decreases the total output of the battery by two volts.

Such an emergency method of repair will be satisfactory until the defective cell is replaced with a new one. A defective cell can usually be located by using a voltmeter; every good cell will cause the needle to deflect, but a dead cell will, of course, not cause a deflection.

Handling Head Sets

Every Western Electric sound installation includes a head set, which is used for testing. Dropping or jarring them tends to destroy the molecular arrangement in the magnet core, with the result that it may become slightly demagnetized. The screw cap on each phone must be kept tight, or rattling and distortion may be the result.

Constant use often tends to loosen the caps, so that it is well to examine them periodically. If it is necessary to remove the cap and the diaphragm from the phone units, when installing a new cord, or for any other reason, the cap should be unscrewed carefully and the diaphragm slid off from the magnets, instead of pulled off. Pulling the thin diaphragm off is likely to bend it and then it will not work well, making replacement necessary.

Noisy Reproduction

On a few occasions, crackling noises in an amplifier have come from a defective resistor. Western Electric amplifiers have many resistors for a certain definite fixed resistance. A defective resistor can be located with a head set, with a "C" battery connected in series.

Noisy reproduction is the most common of all complaints with sound reproducing equipments. During long experience with sound reproducing systems 70 per cent of all troubles fall fundamentally into the noise category. It has been found that the noise problems are the most baffling of all to projectionists and servicemen.

Noises in amplifiers usually occur during the performance and they are hard to find. Noise can emanate from so many different sources. Sporadic hissing, crackling and frying noises are usually caused by short circuits developing in vacuum tubes.

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Crackling and rasping noises are also caused by loose or high resistance connections.

Corroded Tips and Prongs

When the tube tips and the socket prongs have a film of corrosion over them, the grid and plate circuits are especially apt to be affected, which causes a spluttering or crackling noise. Most of the conductors used in Amplifier Circuits are so large that they will seldom if ever be burned out by any amount of current that can reach them. Burnouts are generally found in the tube filaments and in the windings of transformers and chokes and broken connections.

A. C. Hum

It has been found on a few occasions that a steady humming sound, during the presentation of Movietone subjects, was caused by a ground in one of the A. C. lighting circuits in the main auditorium. This caused an A. C. hum, which was very perceptible when the fader was set a few points above the normal setting.

Many Western Electric sound installations include motor generator sets instead of batteries. Crashing and crackling noises at certain times are caused by dirty commutators and sparking at the brushes. Oftentimes sparking at the commutators indicates a short circuit, or an open circuit, in the armature, a leak or ground on the line may also have the effect of overloading the armature of the generator. Commutators and brushes should be inspected at regular intervals. A slow-leaking condenser will cause fuzzy reproduction. The incorrect value of grid leaks and coupling condensers will also cause fuzzy reproduction. Harsh-toned reproduction is caused by increasing the values of grid leaks and coupling condensers. Increasing the filament current, also increasing the plate and grid potentials, will cause harsh-toned reproduction.

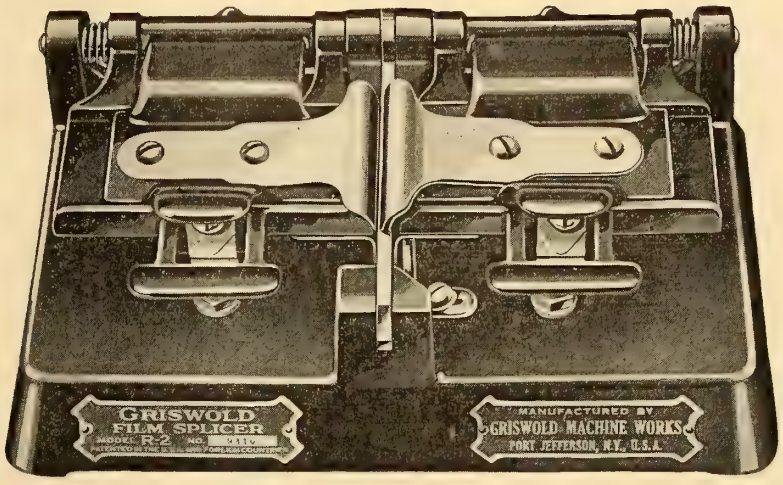
Crashing and crackling noises during Movietone subjects can usually be traced to dry "B" batteries when they are old and worn out. These dry "B" batteries supply potential for the photo-electric cell and plate potential for the pick-up amplifier.

A. C. hum is many times picked up on this circuit, when this circuit is adjacent to a heavily loaded light or power line, which creates induction.

It has been found, where complaints were received about metallic reproduction that in most instances defective receivers have been the cause of this trouble. Oftentimes, the threaded coupling, which holds the receiver in position, works loose and with the higher frequencies, this coupling rattles, which is very perceptible.

Microphonic Tubes

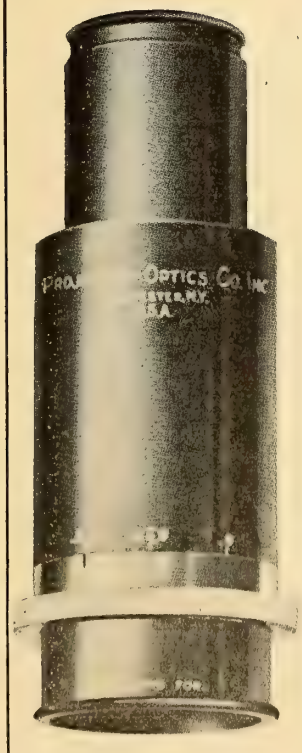
Nearly every projectionist or engineer has experienced the time when by touching or tapping the projector, it would produce a ringing noise,



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Checking Amplifier Troubles

IF all the vacuum tubes show low plate current, the source of plate voltage is likely to be low; if a battery is used, its internal resistance may be unduly high. This situation is usually found only in old batteries. If the plate current in only one of the vacuum tubes is below the limits, it is likely to be making poor contact with one of the springs in the socket. The contact pins on the base of the tube should be cleaned and also the contact springs on the socket should be cleaned and, if necessary, bent a trifle to increase the pressure.

When the plate current of a tube exceeds the limits, the grid terminal is making poor contact with the socket spring. If the plate current of the second and third stages are high, the voltage of the grid batteries may be too low. If, upon a check-up, it is found that the grid voltage is correct, replace the tube or tubes.

Filaments in Series

If the filament of one of the 200-D tubes burns out, then both tubes will be extinguished, owing to the fact that their filaments are wired in series. If all the filaments are extinguished, it indicates that the 3-amp. fuse has blown.

If the amplifier ceases to deliver any output, although it is receiving input and the filaments all are lighted, the .25-amp. fuse has probably blown or the source of plate current supply has been ruptured. If it is found that the fuse has blown, replace it; if it blows a second time, there is some other trouble which will require careful checking. Under these circumstances it is not unlikely that a short-circuit of the socket between the grid and the plate will be found. This can be remedied by taking out the defective socket and replacing the washer.

Noises in the output of the amplifier are likely to be caused by poor tube contacts, defective ground, inadequate shielding of the input, or, perhaps, an unsteadiness of the power supply.

Overload on Amplifier

If the plate circuit of the third stage fluctuates very noticeably, it is an indication that the amplifier is being overloaded. This makes the output quality very poor. The amplification should be reduced by the gain control until the fluctuation disappears. It may happen that even when the gain is reduced as much as possible, overloading still persists. This indicates that the input must then be reduced by inserting resistance in the input circuit. Poor quality may also be due to low grid batteries, poor tube contacts, or defective tubes.

A form of scratching or ringing noise may develop in the amplifier. This is due to a noisy tube, which must be replaced. If the noise is experienced when operating the gain control, it indicates that the control needs cleaning.

Short Circuits

If the amplifier does not function properly and none of the previously named sources of trouble are found to be the cause, it is quite possible that an open circuit, a short circuit, or loose connections are responsible. The best procedure then is to follow the circuit on schematic and test along the line and listen with a pair of high resistance head receivers. This will help to localize the trouble.

Equipment Maintenance Hints

(*Continued from preceding page*)

presenting Movietone subjects. This is called a "microphonic noise." The Movietone amplifier is mounted and swings on a spring suspension for the main purpose of eliminating vibration. If this amplifier does not swing freely, machine noise will be carried through the reproducing system. If there is a microphonic tube in the first stage of the pick-up amplifier it will be worse than ever. Inspect the wiring inside of this amplifier as the wiring may be touching the amplifier some place, which will prevent the amplifier from swinging freely.

Crashing and crackling noises can sometimes be traced to a defective power transformer.

Projectionists....

Progress P A C *Through Understanding*

THE tremendous success of the Projection Advisory Council within the past year has demonstrated the marvelous potentialities of this body as a force for much good in the interests of projection and projectionists. Leaders in every branch of the motion picture industry have lauded the work of the Council, and have predicted for it a long and useful life. President William F. Canavan of the International Alliance has endorsed the aims of the Council and has expressed himself as being highly gratified by the work already accomplished by it.

The amount of good work that can be done by the Council is limited only by the size of its membership and the cooperation tendered the Council by that membership. The Council is your organization, Mr. Projectionist, and its efforts in your behalf will be an accurate reflection of the support you give to it.

In order properly to expand the activities of the Council, an increased membership is desirable at the present time. The membership books of the organization will be kept open until September 15th next for the enrollment of new members.

Projectionists, and all those interested in the advancement of projection, are therefore urged to avail themselves of this opportunity to apply for membership in the Council. Use the blank below to help those who are helping you.

LAURENCE JONES, *Secretary,*
Projection Advisory Council,
Box 98, G. P. O., New York.

I desire to join the Projection Advisory Council. Please send me details and membership application blank.

Signed.....

Street.....City.....State.....

Unsatisfactory Color Film

(From *"The Bioscope"*)

The extraordinary popularity of Technicolor during the past twelve months has had drawbacks as well as advantages. Some of the studios are said to have been using the system as a basis for improvements by their own technical staffs, and claim that nearly as much thought and experimental work has been spent on the improvement of Technicolor as would be needed in the development of an entirely new process. The system is, of course, complete without any of these improvements, but judging by some of the specimens which have reached this country in recent months, the results achieved by different staffs have varied enormously.

In some films the results have been very unsatisfactory, and have led a number of patrons to express preference for black-and-white subjects. Any colour system that is to have wide popular appeal will have to show a much greater range of coloured gradation than has been evident in some recent offerings, and there will have to be much better visual definition on the screen.

Big Market Available

There is a very big market still open for a colour system that is cheap, has a good colour range, is easily manipulated, and does not sacrifice clarity of the screen image. A good system upon these lines will probably be about the best bet in the trade at the moment.

As we have said before, no colour system in sight at the moment may be regarded as a final solution of the colour problem. At any moment they may all be wiped out by a new discovery, which would give us a full spectrum range. That is not to say at the moment there is no opening for relatively temporary systems, which would be better, or simpler in operation, than those on which the industry is at present working.

No Great Attendance Drop

In a recent issue of *The Wall Street Journal* the following report as regards attendance at motion picture theatres is given:

"Movies are an American habit and now that more people than ever have been drawn to the picture houses by sound, any sharp falling off in attendance is unlikely. Increased income is due also to increased admission prices, and to the larger number of new and luxurious theatres owned by the great film producers. A general lowering of admission prices would, of course, considerably reduce profits. Sound has enabled the film producers to offer better amusement in the form of Broadway talent heretofore unavailable to the great mass of the public.

"There is at present no indication that production of wide films for the double width screen will be started on an extensive scale. The additional expense is now considered unjustified to both theatre and producer and the industry is still digesting the two novelties, sound and color. Development of the wide screen will probably proceed when it is felt a new stimulant is needed."



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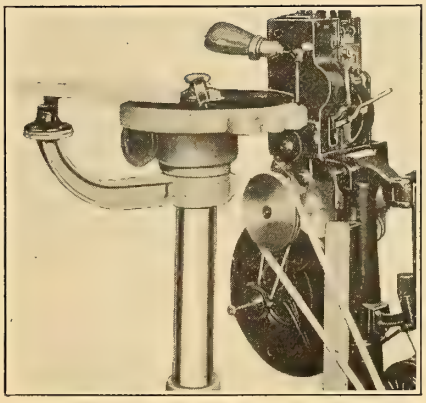
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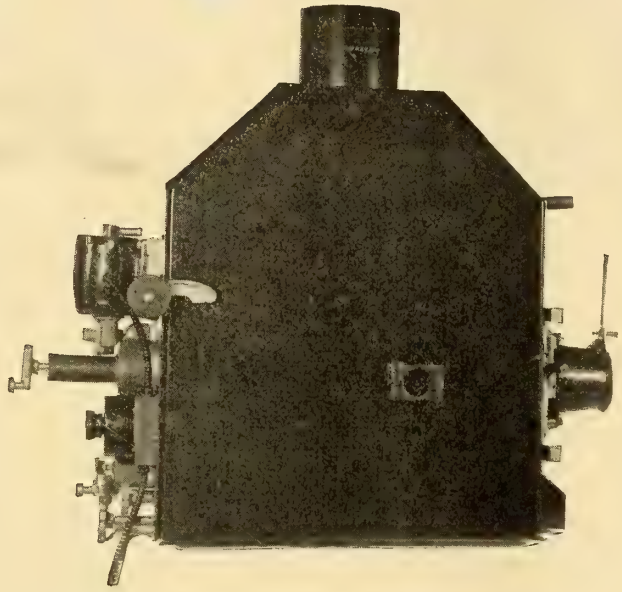
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Let us know your preference, please. All requests will receive attention in the order of their receipt, so act quickly. Use the blank below to tell us in just what subject you are particularly interested. Do it now!

Editor,
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Factors Which Determine the Perfect Loud Speaker

VARIETY being the spice of life, and differences of opinion making possible, in addition to many other things, a horse race, we are pleased to present herewith some highly interesting comment elicited by the item "The Perfect Speaker" which appeared in a recent issue. We are indebted for this pert contribution to Frank Reichman, radio engineer, who, while resident in the mid-West, displays through the medium of a facile pen his cosmopolitan outlook on loud speakers. — The Editor.

JAMES J. FINN, EDITOR
MOTION PICTURE PROJECTIONIST:—

Your article in the December issue captioned "The Perfect Speaker" lays down a set of rules with which to gauge the perfection of a speaker in a charmingly free and easy manner. Your assurance convinces one that you are a master of your subject, that is, of editing a magazine, but you worry me as a judge of loud speakers.

You say "the perfect loud speaker should have a flat response curve over the entire band." What do you mean by a "flat response curve over the entire band?" What do you mean by a "flat response curve?" Maybe you know what you mean, maybe you are falling for some sales propaganda, or maybe you thought this out yourself. Maybe you are referring to a plotted curve made by a microphone, an oscillator, various meters and other apparatus and plotted in Deca B L units. If you are familiar with the apparatus and problems in making these curves and are aware of the questionable character of these units for all really scientific purposes, you should, in my opinion, hesitate to endorse a flat response curve plotted in Deca BL's as perfect or even as desirable.

Maybe, however, you did not intend to be drawn into an argument as to the correctness of method in the plotting of curves, nor into the authority for or the desirability of the Deca BL unit, but meant instead simply that the ear should hear an equal volume of sound at all frequencies over a pure tone oscillator; and if apparatus, mathematics and desirable units of electrical measurements are not yet available to plot this accurately in a curve, let them be expressed by a straight line on a piece of cross-section paper, so you can print it in your magazine. If this is what you meant, let me ask you this:—Would you like to hear a symphony concert where the conductor attempted to sound the higher frequencies as loudly as the lower frequencies? You cannot possibly mean this.

You know, do you not, that in order to emphasize the voice range, theaters in purchasing speakers for the "talkies" insist upon the lower frequencies

(*Continued on page* 48)

Charging Current Characteristics

Due to the nature of batteries when charging, the current will taper off as the batteries become charged. The action of the charger (except when batteries are run down until they sulphate, in which case the variation will be greater), will be about as follows:

Charging Rate

Start at, say, 13 amps. and within one half hour the rate will drop to 9 or 10 amps. The charger will then hold this rate within an ampere until the batteries reach full charge when the rate will drop off 2 or 3 amps. more. If, after the first half hour the rate is again increased to 12 or 13 amps. it will hold at that point until completion of charge where it will taper to about 9 to 10 amps.

Any variation of the A.C. voltage will affect the charging current somewhat, and if the A.C. supply fluctuates badly it is best to keep the charging rate around 10 amps, as an average. This will allow for fluctuation both up and down without putting an undue strain on the charger and bulb should the rate increase several amperes.

Overnight Charging

It is always best to leave the rate at not over 10 amperes if the charger is to operate all night without an attendant, whenever there is any trouble with voltage fluctuations. This is because in many locations the voltage rises from 8 to 10 volts around midnight, when the lighting load drops off. This additional voltage will cause a 3 or 4 ampere increase in the charging rate. If the rate is left at 9 or 10 amps., this increase will not harm either the charger or batteries.

A tapped resistance is provided in the Hart panel which should be set to provide the proper charging rate of the "B" batteries. This rate is set when the charger is installed and need not be changed unless the number of "B" batteries to be charged is changed.

Westinghouse Acquires New British Patent Rights

A patent licensing agreement has been entered into between the Westinghouse Electric and Manufacturing Company and English Electric Company, Ltd., of Queens House, Kingsway, London, England, whereby the former corporation will acquire a minority interest in the English concern, thus giving the Westinghouse interests a new alliance in the United Kingdom.

License Arrangement

The Westinghouse Electric International Company has concluded a comprehensive arrangement with the English concern for an exchange of technical information on electric apparatus.

The arrangement includes the granting of licenses for the use of patents and for the manufacture and sale of various products, and is effective throughout the British Empire except in Canada. The licenses will be subject to existing commitments of the two companies in various parts of the world.

Interchange Research Work

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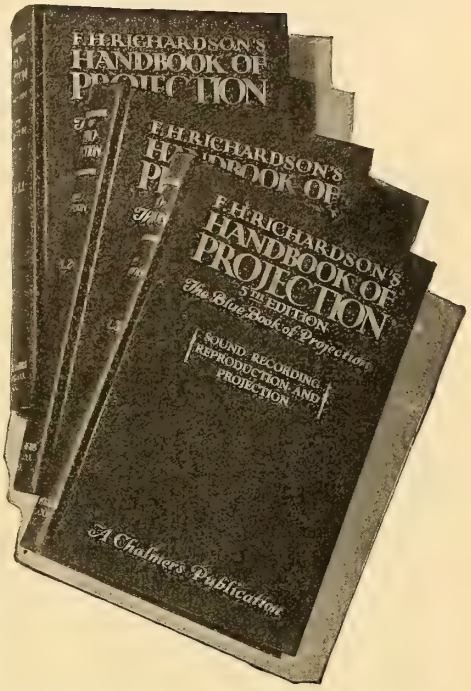
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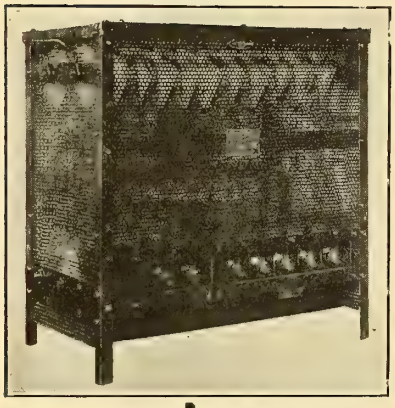
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(*Continued from page* 46)

being subdued, in comparison to a speaker designed for use on a home radio? So do you want a "flat response curve" in a theater speaker, or in a home speaker?

Maybe you mean that the response curve of the perfect speaker be plotted on flat paper and then the paper be viewed edgewise. I am trying to understand just what you mean. Now I do not mean to be just disagreeable and difficult, I only wish to help kill this propaganda about the desirability of a flat response curve in a speaker.

Nobody really knows what a flat response curve is, and of all the different kinds persons conjur up in their minds when this is mentioned, upon analysis they always seem to find that if it is flat, that they do not want it.

Now, let us modify this word "flat" and change it to "desirable." Does this sound better, "desirable response curve?" Let us understand that by "desirable" we mean whatever response curve that will correct for the inaccuracies of broadcasting or of recording and of the radio set, or amplifier and pick-up, as the case may be, and deliver to the human ear in the home, auditorium, or open air the full range of sound frequencies in the proper relative intensities that they should possess. We cannot even say that these frequencies should be delivered to the ear in the same relative intensities as they are produced in the broadcasting or recording studio, because often the various instruments in a studio orchestra are played with quite different relative sound volume in the studio than they would be in a concert hall. This is to correct for peculiarities of the studio, the microphones, and other apparatus.

Also bear in mind that the relative intensities of highs to lows in order to affect the human nervous system the same, must be different for a small room, an auditorium, and the open air. Since the medical men say that we hear the high notes through the head bones and the low notes through the stomach, shouldn't we also further correct for the differences in the sizes of peoples' heads, and well, certainly, for stomachs?

Certainly the response curve of a speaker should not be flat; it should be curved to meet conditions.

This talk about the desirability of a *flat* response curve is harmful because it is so incorrect. Really, it is pure "bunk," just sales propaganda indulged in generally by those who do not know any better. Response curves have some benefit in laboratories for showing relative response characteristics of speakers, providing the laboratory work is careful and skillfully done, but they are for laboratory and highly technical use and should not be used to mislead the public.

Another and even more important reason for attacking these loose

references to "flat response curves" is that discussion of tone quality so often stops and rests at that point. Now, really, the fact is that good tone quality is much deeper and more intricate than just a good response curve. To make myself clear, I agree that a speaker must have a "desirable" response curve. This *must* be good; but when you have that you have only one little thing involved in creating a fine musical instrument, such as a good speaker must be. Whoever heard of the response curve of a piano, or of a violin? Would you buy either one because of an attractive looking response curve? They can be is so much deeper than this in musical drawn, but tone quality, good or bad, instruments that such a thing is not mentioned.

Who cares about the relative amount of muscle, a little more or a little less, than it takes to play low notes or high notes on a violin or a piano, or the pounds pressure of air to blow high or low on a saxophone or tuba? Who cares? Why bring that up? By the way, since you like flat responsive curves, draw the response curve of a drum and a cymbal.

Since a loud speaker must be a violin, a piano, an entire orchestra, a brass band, Martinelli, Galli-Curci, Al Jolson, John Barrymore, Gloria Swanson, a pipe organ, everything and anything in music and sound, its ability to be that exact instrument or person with lifelike perfection should be the most important thing about it. The perfect speaker should be judged by the same standards as any musical instrument. It should portray the difference between a poor and a fine violin, the difference between a cheap and a good piano. In its reproduction of an orchestra, each instrument in that orchestra should stand out and be there in all its quality and characteristics. This I call "definition."

In reproducing the human voice, that person's voice must not only be recognized but you should be able to close your eyes and that person should be absolutely before you. This illusion should be created.

The tone quality of a speaker is a question of whether it shows the difference in a fine violin or a poor one, in its definition of the different pieces in an orchestra, in the extent of the illusion it creates as to the presence of the speaker or singer. These are the points of merit that should be agitated and discussed about a speaker. It must have a desirable response curve, of course, but this varies widely for different applications and can only be met by an extensive line of speakers.

And I will sign off with the response curve of a flash of static.

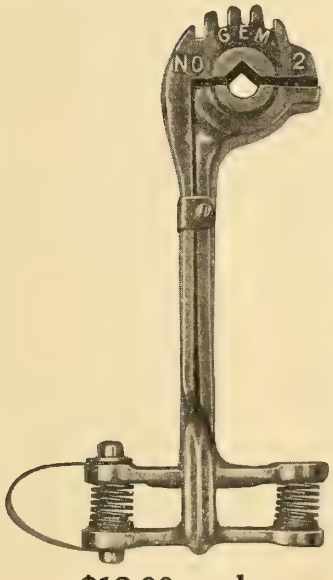
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Cure For Auditorium "Dead Spots"

IN the theatre of the future the dead spot will be a thing unknown. Long before building commences it will be certain that every seat will receive sound perfectly. One of the latest American developments is the detection of dead spots from the architect's plans. This is achieved by a process known as "Photo-Echo Analysis" which has been developed by the Burgess Laboratories, in Madison, Wisconsin.

Testing Procedure

The procedure is as follows: The floor plan of the auditorium, as well as the longitudinal and latitudinal cross sections, are laid out to scale on stiff white paper. In each case the section to be studied is fenced in by a strip of highly polished metal, which is placed in exact conformity with the outline of the section. For example, if the floor plan is being studied that metal strip should exactly correspond with the auditorium walls. An electric lamp is placed on the site of the stage and an "aeroplane" photograph is taken.

"Photograph" Sound Waves

Naturally the metal "walls" reflect the light from the lamp and a record of the resulting light rays is obtained in the photograph. Since sound waves are reflected in a similar manner to light, the photograph gives an indication of how the sound will be reflected.

If the diffusion from the walls is uniform, all is well, but if there is indication of a number of rays meeting at any one point it will be found that reflected sound will there be of sufficient strength to interfere with sound coming direct from the stage. The obvious remedy for this is to alter the shape of the walls so as to eliminate the convergence of the rays.

Effect of Ceiling Shape

In estimating the effect of ceiling shape the procedure is similar except that pegs are inserted to represent listeners and rather more care is needed to track reflections. Careful measurement of the distance covered by the sound direct from the stage and by the reflected sound is then made. If the difference between these distances is over 35 feet, it is a fact that acoustical trouble will result.

To show non-reflecting surfaces it is necessary to blacken the strips of metal corresponding to those areas. Sound absorbent surfaces are indicated by covering the metal strip with a non-reflecting grating. If the grating has a closed area of 50 per cent it reduces the intensity of the reflection approximately as much as a 50 per cent sound absorbing surface reduces the reflected sound.

New Small W. E. Horn

The Western Electric Company now has on the market a new horn for houses with restricted stage space. Tonal capacity remains the same.

Warners Backing a New Projector Head

AT the Warner Brothers' studios in Hollywood, considerable experimenting has gone on with a "three-way" projector, a silent motion picture camera for use in recording sound films and color.

This three-way projector, geared to take either 35mm., 65mm. or 70mm. film by merely turning a knob to the prescribed notch, is the highlight of the research work in which the studio has been indulging. What this means to the exhibitor is obvious. A theatre can order these projector heads for its booth machines and the Warner mechanics say they'll be able to make a complete installation in a normal room (two projectors) within half an hour after they start to work. No price has been set upon the new device but the Brunswick plant at Muskegon, Mich., will turn them out as well as the silent cameras.

The changeover to any width on the projectors is accomplished by a series of accentuating cams, so arranged that the operator but turns a small metal knob, attached to the lower magazine, to make the switch on the sprocket cylinders. A similar movement takes care of the aperture, which is fan-cooled, and the original installation includes a permanent but special lens, aperture plate and the new cams. The "head" is designed for Simplex projectors.

In order to light the enlarged film properly the projectors will probably have to pull 200 amperes, just double the normal load. It is pointed out that this quantity of juice will be sufficient for any throw up to 200 feet, more than any modern theatre employs.

The Silent Camera

The silent camera is another source of pride to Warner Brothers. This camera, of which three are ready for use, employs many new principles, including the motor inside the housing, besides dual "finders" for the cameraman, in that he really sights through binoculars. This, it is insisted, for the first time gives the cameraman the exact image as it will appear on the screen.

An especially constructed two-inch lens permits universal focus (keeping both foreground and background sharply defined), while also allowing an escape from the claimed "flat" lighting with which, say the Warnerites, the big film stuff to date has been afflicted. These, and what further evolves, will be made standard equipment on all Warner cameras in either the small or large size.

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...BUT ON WENT THE SHOW!

Friday night at the LYRIC... The feature was on, everything running smoothly as usual. Then, a mechanism froze... There wasn't a very large crowd—that show didn't mean so much. But the next day, Saturday, is a weekly box office picnic at the Lyric. The matinee gets good attendance and the two evening shows pack 'em in... Yes, there was negligence involved—there usually is. The complete overhauling of projectors had been recommended some weeks before but it's human nature to put things off... And now in a jam—what?.. There was a hurried phone call to a National Branch. For half an hour one projector did the work of two. Then a National Repair Expert was in the booth and on went the show! No loss of patronage. No cut in Saturday profits... That's the sort of rush repair service National has made available to every American exhibitor. A phone call to your nearest National Branch will get results—as quickly as it's humanly possible to get them; as reliably as the skill of Expert Projection Repair men can make them.

Emergencies are poor things to wait for. You can avoid them by asking your National Representative to make a periodic check-up on your projection equipment. If repair work or overhauling is needed the National Repair Department will take care of it for you. Factory methods. Genuine repair parts. Equipment to replace your own while the work is being done. Moderate charges. Ask at your nearest National Branch for further detail

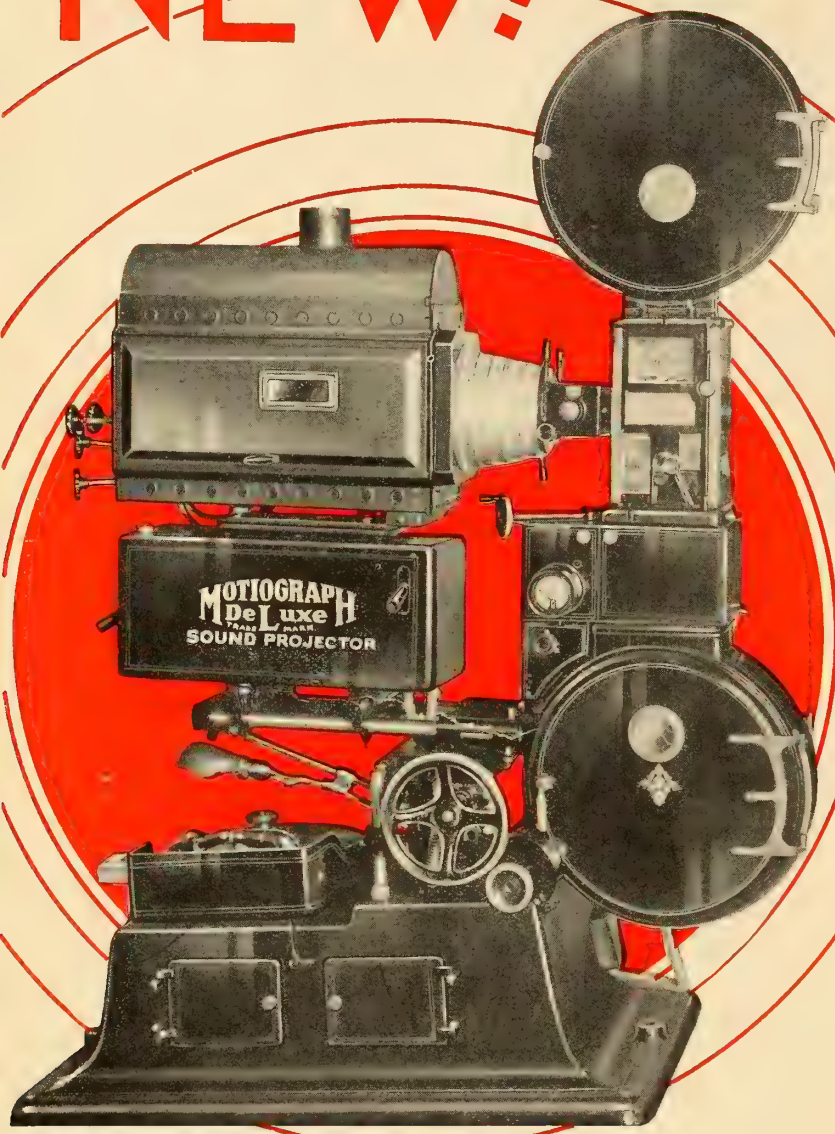
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MOTIOGRAPH DE LUXE SOUND PROJECTOR



The only motion picture projector designed for and having sound on film and sound on disc equipment built in as an integral part of the projector.

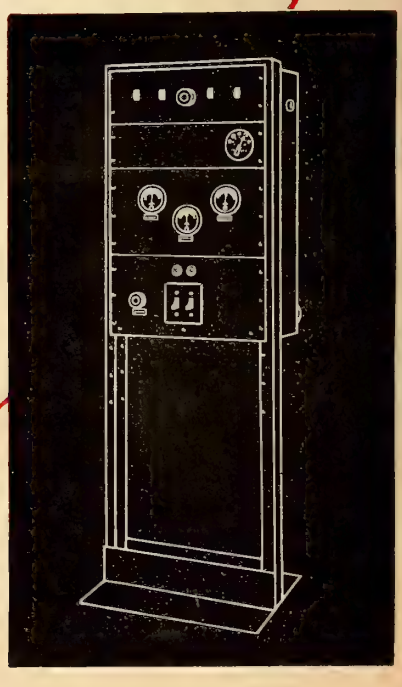
Perfect operation and co-ordination of motion picture projection and sound reproduction assured.

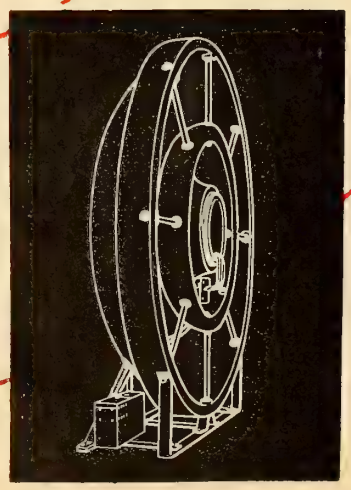
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MOTION PICTURE PROJECTIONIST

The International Authority

THE LENS THAT PUTS PERFECTION IN PROJECTION



No. 1—In position for sound film.

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Projection Lens—

Comparative test with any other make will prove their superiority

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Greater Brilliancy

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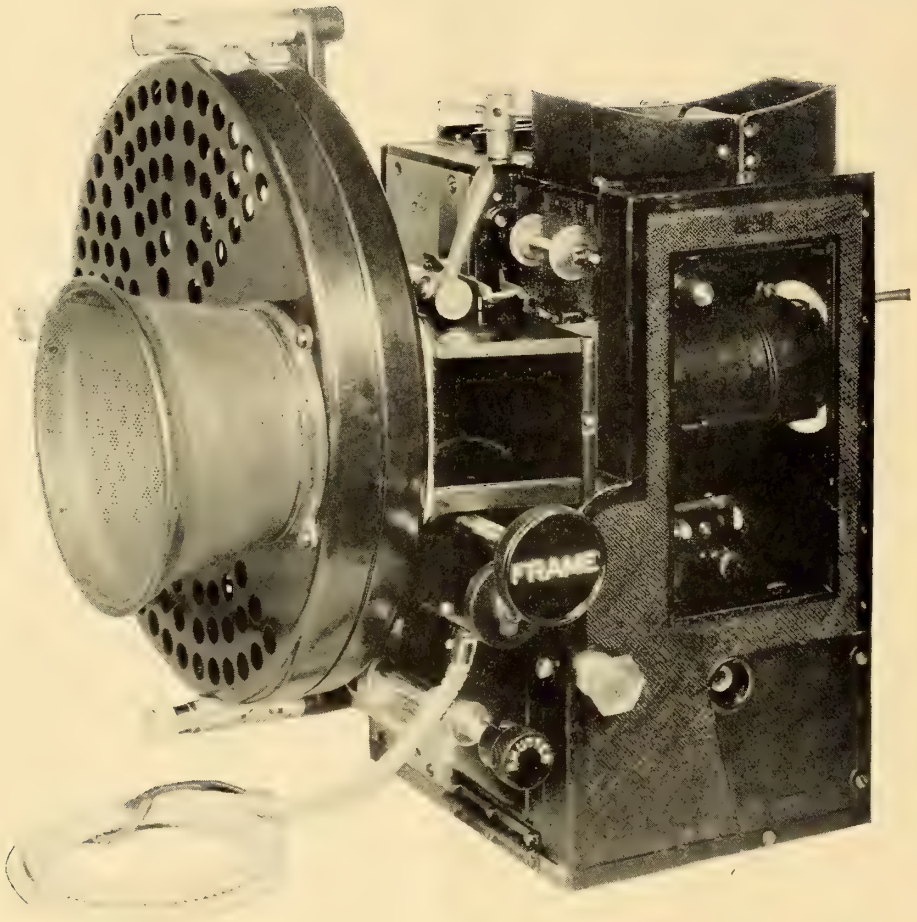
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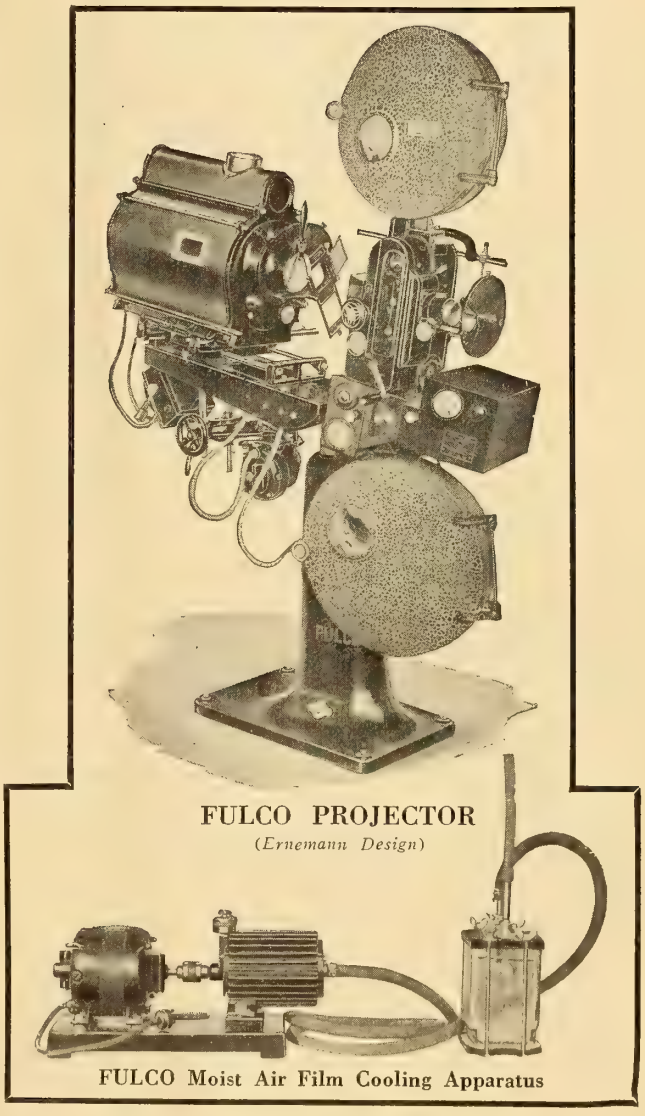
Present day projection arc lamps employ more amperage than formerly, and competent engineers predict much heavier currents because of insistent demand for more light to meet the need of larger pictures, and to overcome film density, color and "sound" screen porosity. As amperage rises, film heat difficulties and dangers increase.

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The Fulco Moist Air Film Cooler is a complete, separate unit and may be added to Fulco Projector installation at any time.

BE PREPARED—
EQUIP WITH FULCO PROJECTORS



FULCO PROJECTOR
(Ernemann Design)

FULCO Moist Air Film Cooling Apparatus

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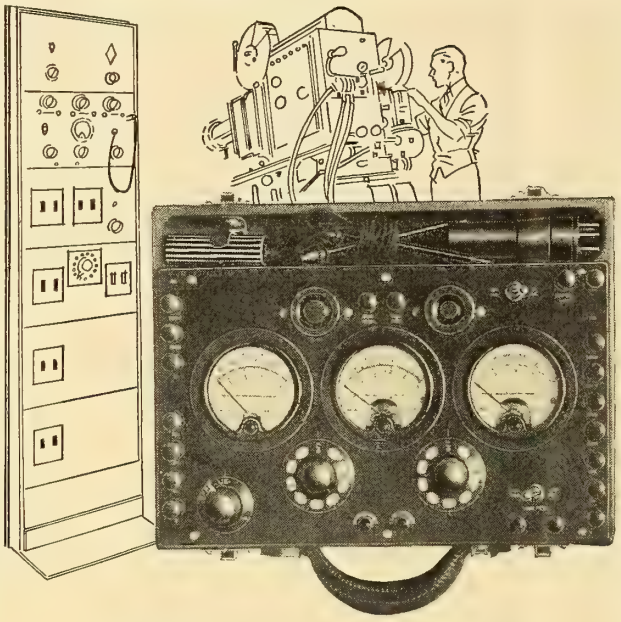
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Authorities on Sound Projection agree you need good, accurate, dependable electrical measuring instruments to maintain and keep your Sound Apparatus working efficiently. They, as well as engineers, laboratories and colleges accept Weston Instruments as the world's highest standards of fine design, precise manufacture and dependable service.

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MOTION PICTURE PROJECTIONIST

September, 1930 Vol. 3, No. 11

JAMES J. FINN, Editor

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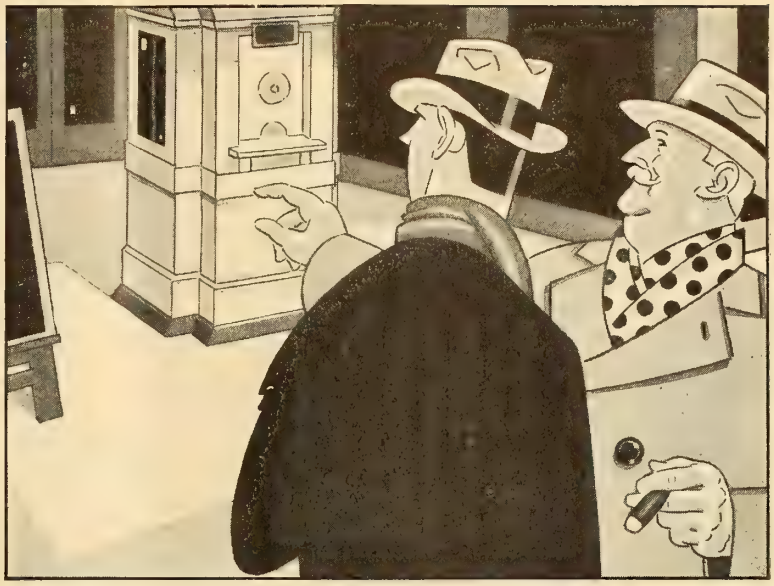
Motion Picture Academy Merit Awards Due

NOMINATION blanks for the Merit Awards of the Academy of M. P. Arts & Sciences for the year ended July 31, 1930, are now going out to the different Branch memberships of the Academy. One new award has been added to the list, namely, "Sound Recording," making nine awards in all as follows:

1. Actor—Best performance or performances; 2. Actress—Best performance or performances; 3. Director—Best achievement or achievements; 4. Art Director—Best achievement; 5. Cinematography—Best achievement; 6. Sound Recording—Best achievement; 7. Scientific or Technical—Best achievement; 8. Writing—Best achievement; 9. Production—Outstanding picture of the year from all aspects.

Technicians Awards

Sound recording has been the most difficult of all technical problems to solve, in relation to the Academy award. It was at first thought that there was no just and equitable method by which proper credit could



They would tell their best friends any day

NATIONAL PROJECTOR CARBONS produce a brilliant light that recreates the realism of any picture. This light is pure white, and can be produced in any intensity needed to place a clear picture on the screen of even the largest of theaters. Even on higher intensities, they give this clear light without spitting or sputtering! If your customers like your films (and "fuzzy" projection can ruin the best of films), you may be sure that they will tell their best friends—and any one else. Best advertising for *any show* is by word of mouth. With good films and good projection your theater will stay crowded. National Projector Carbons will help you by helping to keep the crowds coming.

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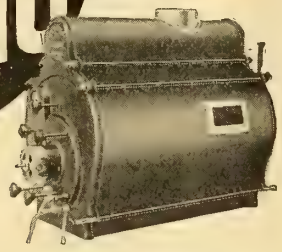
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Authorized distributors for
SIMPLEX—MOTIOGRAPH—POWERS—HOLMES
and all theatre equipment of the leading manufacturers. Also, an extensive line of stage equipment.
Complete Sound Picture Service!
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Automatic Reflector Arc Lamps



Made by a concern everlastingly keeping up with the pace of the industry.

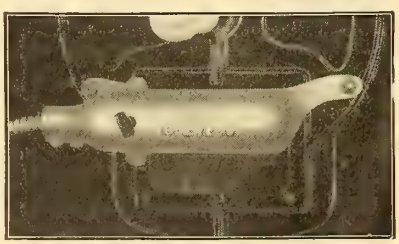
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"BEST"
Magazine Light



attaches to side of magazine illuminating the inside showing the exact amount of film on reel from either side without opening door.

Price $3.50 at your dealers

BEST DEVICES CO.
200 FILM BLDG., CLEVELAND, O.

be ascertained and accorded to those individuals to whom recognition was due for exceptional results in sound recording.

The Technicians Branch Executive Committee in conference with sound engineers, however, came forward with a solution. They proposed that the award should be to the sound department responsible for the sound recording of any production chosen by the Academy as having the best sound recording of the year. The trophy could go to the department, like a cup or medal won by a team in any other contest, and the persons who contributed to the victory could be awarded certificates of some sort signalizing their participation. On this basis the Award was voted by the Board.

As finally worked out and as provided in the regulations, the award for Sound Recording is for the picture in which the best results are obtained "with reference to the most convincing use of sound."

May Name 3 Pictures

Each member of the Branch will, therefore, vote for three pictures, which, in his opinion, present the best over-all sound recording results.

To give the members of the Branch a fair opportunity of comparing sound recording quality in various productions under equal conditions, all studios have been invited to present examples of recording from pictures eligible for award. It is expected that these exhibits, limited to 1,000 feet from each studio, with 500 foot exhibits from any three individual members of the Branch, will be ready for exhibition to the Branch very soon.

Theatre Television Also Shown in England

A demonstration something like that given by Dr. E. F. W. Alexanderson at Schenectady, N. Y., recently, when television was shown on a screen in a vaudeville theatre, was made in England by the Baird Television Company on a screen 3 x 6 feet. The actors appeared in a studio, the images were sent by land wire to a broadcasting station, and the station's wave was picked up by a receiver at the theatre.

Improved Baird System

Heretofore the Baird system was confined to vieving television through a lens, so that one person at a time saw the reproduction, but now the system has been improved to include projection, so that many can see the images at the same time on a screen.

There was no sound track in the demonstration, which took place at the British theatre. Alexanderson however, used sound, to constitute television talkies. Work along the same line is going forward in Great Britain.

An Advertisement Every Serious Projectionist Should Read With Care



TELEVISION is just around the corner.

Without question Television is one of the greatest achievements of the human mind; it is also one of the greatest forces for human progress. Like the great inventions that preceded it—the telegraph, the telephone, and radio—it will annihilate space, and make it as inconsequential as a city block.

Ten years ago Television was a faint glimmer which our scientific men discerned in a shadowy world of possibilities. The application of their genius and industry has today made television a fact. People already are able to see each other, although thirty miles apart. The further refinement of the instruments already developed will shortly make the thirty into three thousand, then thirty thousand miles until we, in New York, will be able to see instantaneously others at the extreme farther side of the world.

Industry, of course, will turn Television to its manifold uses at once, as it has done with all inventions. Can it be used for recreational, for entertainment purposes also?

Of course it can—and it will! The great business and industrial institutions of this and other countries that are now backing the development of Television will immediately apply it to the theatre. Millions of homes will be equipped with Television receiving sets, as they now are with radio, and the motion picture theatre will harness it for its own use.

Right now there is a great deal of speculation concerning the nature of the kinship between Television and the motion picture theatre. Some say that it may do away with the theatre—that everything the theatre offers today, music, photoplays, dancing, chorus girls, singing opera stars, musical comedies,—will come straight into the home by means of radio, and Television. Others declare that it will do away with photoplay production—that the story will be acted out before the Televisor and broadcast immediately into the homes and motion picture theatres. Still others—and there are eminent authorities of the theatre and scientific world among these—state that nothing will be changed, that Television will simply help the theatre to further amuse its patrons, just as *sound* pictures have done. It will not hurt the theatre, but help it.

There is no doubt whatsoever that the motion picture theatre will continue to exist—and will turn Television to its own uses. Roxy, master showman of all time, has declared publicly that he is waiting impatiently for the perfection of Television, that he will at once harness it to his showmanship genius and apply it in the Roxy Theatre. Other magnates are even today making provision for Television equipment in their new movie hippodromes.

There has been talk already of the exact application of Television to the theatres. Dr. Lee De Forest, a man of science and of vision, thinks that Television will become a monopoly of the telephone companies; that these will supply and install the necessary equipment for public and private uses, as they now do the telephone instrument; that they will supply entertainment via Television, the same way they now make telephone connections, that is, by request of the renter of the equipment, and will charge them accordingly. Dr. De Forest has even declared that these charges will be added to renter's monthly telephone bill. The theatre will make use of it this way.

Perhaps this is the way it will be done. Why not?

Another question concerns the nature of the equipment which theatres will use for Television. That question cannot be answered now. It may become part of the equipment now in use in the motion picture theatre projection room; it may be necessary to place it on the stage and project on the screen from the rear—it may be one or both of these processes. But this is certain—theatres will need new equipment for Television *and smart men to operate it.*

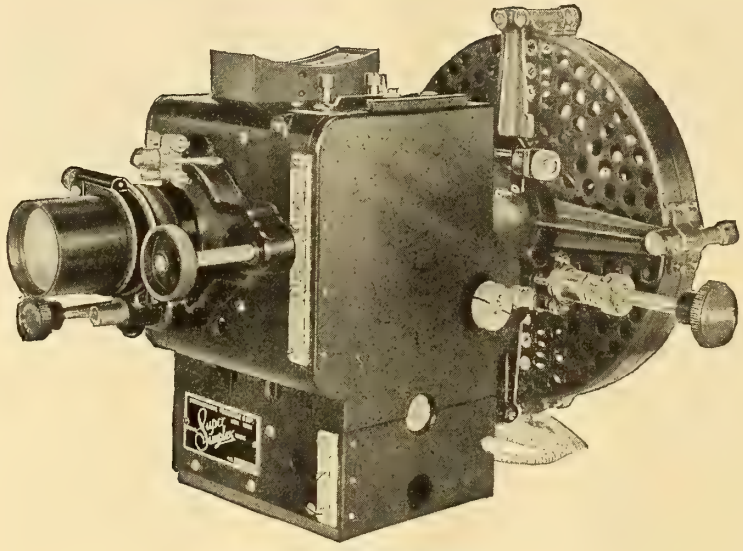
Boone Maneall

Order a copy of TELEVISION today—price $3.50. SOUND PROJECTION ($6.00).

The price is $8.00 for the two books. Order from the MOTION PICTURE PROJECTIONIST, 45 W. 45th St., N. Y. C.

Every Theatre Owner
Manager and Projectionist
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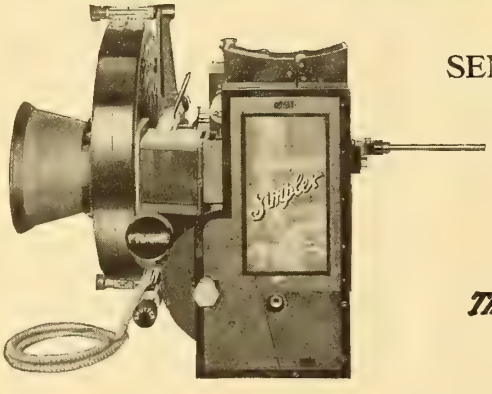


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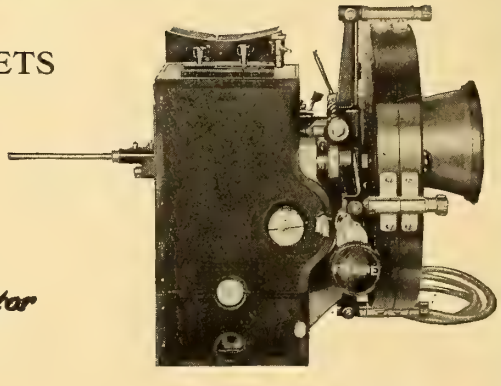
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Three-Dimensional Vision

By HUGO LATELTIN

THE third dimension—that is, depth—is purely a mental concept. Although we can ultimately reduce all knowledge of the physical world to the status of a picture in our minds, we find this procedure particularly applicable to a proper understanding of three-dimensional vision. Without the aid of our minds we would never visualize the world of objects around us as it appears to us today. In the process of analyzing and abstracting the mind constructs an image of the world which is different from the picture our eyes see. A brief consideration of the sensory aspects of seeing will quickly explain this seeming anomaly.

The eye in its physiological construction is comparable to a camera. In the eye we find the lens (of the eye), the iris (formed by the pupil), the eye chamber filled with a vitreous fluid, and the retina which is the seat of the nerve ends which transmit light stimulations to the brain. In a camera we also find a lens, iris, chamber, and light-sensitive plate or film.

The picture which is projected onto the plate or film of a camera is purely two-dimensional. This is equally true of the picture which the eyes see on the retina. As the retina is approximately a plane surface, a picture received by it has no quality of depth.

But we *see* objects—or, at least, we assume that we can perceive them. This is a fallacy. The eye, like all organs of sense, is able to perceive in only two directions. In the sense of sight, this is a plane; in the sense of touch, the surface with which we come in contact. But we neither see nor are able to touch objects: that is, objects have three dimensions: width, height, and depth; and the closest we are able to approach them is by seeing one aspect of them or, with the sense of touch, by touching the surface. Thus it can be seen that we are unable either to see or touch objects *in themselves.*

Process of "Seeing" Depth

We therefore have to seek elsewhere for an explanation for the process of *seeing* depth, and we turn naturally to the mind which receives the sensory stimuli of the retina through the optical nerves. The principal function of the mind is, of course, to form concepts, that is, to abstract on the basis of two or more given data a new concept which, although containing all the individual parts, is entirely different from them. Thus, two plus three equal five. In this process of reasoning "five" is the new concept formed, truly the *sum* of three plus two but totally dissimilar in our minds from either.

Another example lies in the consideration of the concept "animal." While our eyes "see" and our ears "hear" cats, dogs, horses, etc., they never see or hear an animal embodying all the characteristics of cats, dogs, horses, etc. "Animal" therefore is purely a concept of the mind and in reality has no physical existence.

The same holds true regarding the problem confronting us in three-dimensional vision. The "third dimension" is purely a mental concept, for we neither see nor are able to touch the third dimension in any object. We see the different aspects of an object two-dimensionally; we touch the different surfaces of a body and, drawing on our memory and experiences, we form a new picture of the physical world. This picture, although different from what we actually "see," is much closer to a real understanding of objects in nature. (It is an established fact that persons not endowed with a well-developed conception of depth have a faulty memory.) We are able then to *conceive* a house, a cube, a ball, despite the fact that we see only limited views of these objects in a two-dimensional plane.

The foregoing has a direct and interesting bearing on the solution of the problem of the third dimension in motion pictures, usually termed "stereoscopic" pictures, and will help to clarify somewhat the problems involved and to segregate the sensory from the mental aspects of the question. Our efforts from this point on will be directed to the purely sensory side of vision without further regard at this time to the causes of *seeing* depth.

Duplicating the process of the sensory part of seeing will surely bring us nearer to a solution of this vexing question of three-dimensional motion pictures. This feat has already been accomplished but not in a degree practicable for motion picture purposes.

Before entering into a description of the known methods of producing depth in pictures it would be well to consider the most favorable conditions under which we usually see objects in nature with greatest depth. All rays which enter our eyes have a certain color and brilliancy. That colors are helpful in conveying an impression of depth is an established fact, as can be proven from a close inspection of colored motion pictures which quite frequently increase the illusion of depth to a marked degree.

Brilliancy or the intensity of light and shadow is equally important in the proper visualization of objects. A hazy landscape, for example, has very little depth, for therein the contrasts between light and shadow have been minimized. This is also apparent at night when both far and near objects are frequently seen in one plane.

It is, therefore, essential to have the highest possible contrast in colors and brilliancy, for only through contrast are we able to see different objects in nature. All methods and effects which help to remind us of the real objects in nature, when seen on a screen, will increase the illusion of depth. The effect of color and shadow have been exhaustively studied in connection with the taking of pictures.

One factor in seeing which outweighs all others is binocular vision. Before advancing to a consideration of this phase of the problem we shall review briefly the factors which are helpful in creating an illusion of depth in monocular vision, that is, seeing with only one eye.

Monocular Vision

The recipient elements of the light rays in the human eye are the *cones* in the retina. Their diameter is approximately 0.005 millimeter. As the cone is connected with only one optical nerve leading to the brain the response to one or more light rays might be termed a "singular response." Objects such as two stars, for example, which are not sufficiently separated to be perceived by two separate cones are seen as one. The required separation is about a one minute angle, having its vertex in the lens of the eye.

In the process of seeing we fix our eye on one point at one instant. A line drawn from the point of fixation through the lens of the eye to the retina is called the *optical axis.* In order to perceive the form of an object it would be necessary to successively direct our eye to a sufficient number of points to enable us to judge accurately its form. These points of fixation are quite frequently located at different distances. The eye lens possesses the ability of accommodating itself to these varied distances. Without this characteristic of the eye lens our vision would be extremely limited.

The resultant image on the retina, due to the movement and "accommodation" facility mentioned above, is a perspective copy of the world around us. This perspective picture changes with a change in the object being viewed or with a displacement of the eye. The greater the number of different views we gain of an object the

clearer will be our conception as to its form and substance.

The viewing of motion pitcures, although seen with both eyes, can be compared with monocular vision. Any displacement of the eyes has no effect on depth, as the picture being viewed remains always the same and represents only *one particular aspect of an object at one instant.* If we reverse this process and view a motion picture taken with a camera moving on a stream, train, motor van, etc., we receive a perceptible improvement in the illusion of depth due to the ever-changing aspects and views of the object being observed.

When looking into a mirror with only one eye we see a reflected picture. As this picture is not stationary but changes with the slightest displacement of the eye, we receive an impression of depth which is equal to looking at the real object.

There are cases where monocular vision gives a better impression of depth than does binocular vision. When looking at a painting or photograph with one eye from the original point of sight either with the plain eye or through an open tube or peephole, we notice a considerable increase in depth. This effect can be satisfactorily explained when we stop to consider that the painting or photograph represented only one-eye views of objects. By seeing them with both eyes we are easily reminded that the picture is only a flat representation of a real object.

Although monocular vision will give a plausible conception of depth, it is far from being complete. When looking at a landscape or a group of buildings for a time with one eye, immediately following which we open the other eye, we notice at once the surprising differences in depth between the two methods of vision. This will indicate our next consideration, binocular vision, which is vision with both eyes.

Binocular Vision

Looking at an object with both eyes we receive two dissimilar perspective images in both the right and the left eyes. This dissimilarity is the result of the separation between the two eyes (approximately 2¼ inches), and the distance from the eyes of the object being viewed. There exists a certain upper limit beyond which stereoscopic vision is no longer perceptible; this limit is about ⅔ mile. Because of this limitation far-off objects are seen in a plane, mountains appear close together. The stars, although separated by enormous distances are all seen on one plane. The lowest limit in stereoscopic vision is about 10 inches.

Numerous methods have been employed to approximate binocular vision, although they all agree on one point, namely, that the left and right picture view must be seen by the corresponding eye.

This is the first of a series of articles by Hugo Lateltin on stereoscopic motion pictures in which the development of this art will be recorded, the present status recounted, and the probable future course charted. Mr. Lateltin, a member of Local Union 306, N. Y. City, will be remembered for his previous contributions to these pages in the field of optics and light

There have been attempts to create depth in motion pictures by constantly shifting the camera, simulating through this process the displacement of the eye in monocular vision,[1] but as a complete depth impression can only be obtained when based on the principles underlying binocular vision, these attempts were necessarily unsatisfactory.

Stereoscopic Still Pictures

Still pictures have hardly any direct application to motion pictures. It is only necessary in this article to consider the methods used in stereoscopic still pictures insofar as they are interesting from the standpoint of the production of motion pictures.

The inventions relating to stereoscopic still pictures can be classified into two groups: (1) stereoscopic pictures which require an analyzing medium in front of the eyes, and (2) those which give stereoscopic relief without the aid of an analyzer. This latter class is naturally of much greater interest in connection with motion pictures than the former.

It is possible to experience the sensation of depth in viewing a left and right eye picture without the aid of a special instrument. In looking at two dots spaced about 2½ inches apart and focusing our eyes on infinity, we will notice that the two separate dots are gradually moving together, until finally they merge completely. This procedure can be tried, after some experience with the previous experiment, and actual stereoscopic pictures and depth will be realized.

This mode of viewing is obviously rather difficult, and instruments have been available for the past hundred years to facilitate the viewing of stereoscopic pictures.

Wheatstone and Brewster have constructed stereoscopic apparatus for viewing the left- and right-hand pictures separately. Probably the best known such device dates back to Brewster who constructed an instrument known as the ordinary stereoscope which enables both eyes to see the corresponding stereoscopic pictures through lenses. To experience an impression of depth, equal to the genuine, it is necessary to view the two photographs under the same optical conditions as were used in taking the stereoscopic views.

An interesting and most promising invention for possible use in the development of three-dimensional motion pictures has been recently perfected. In place of the conventional analyzer used before the eyes a lined screen is placed in front of a specially prepared photograph. The eye is absolutely unaided in viewing the picture, and the effect obtained is strikingly realistic, that is, a perfect impression of depth is obtained without the slightest effort on the part of the person viewing the photograph with both eyes.

SEVERAL methods based on the lined screen have been perfected. None come so close to the common goal as the method developed by Dr. Kanolt.[2] His method enables the observer to view a photograph within a large angle, giving different stereoscopic views of an object.

"The photograph is taken (I quote Dr. Kanolt) by moving the camera in an arc around the object while the exposure is being made. The plate holder of the camera contains a lined screen which consists of a glass plate having on its rear surface an opaque black coating with parallel transparent lines in it. These lines are vertical and are very narrow. During the exposure the photographic plate is moved horizontally, the total distance it moves being about equal to the distance between two lines. At any instant the camera forms a photographic image only on those parts of the photographic plate that lie immediately back of the transparent lines. This image presents the aspect of the object photographed as seen from the particular position the camera occupied at the time.

"After the photographic plate has been developed a positive transparency is made from it by printing on a glass photographic plate. This picture, when viewed directly, has a blurred appearance, for the reason that it presents to view all the images produced on the plate in the various positions of the camera. But when a lined screen is placed in front of the picture and spaced slightly from it and the two are viewed by transmitted light, the lined screen permits only a single clear picture to be seen from each direction. Then as one walks past the picture he sees changing aspects of the objects in the picture just as though he were passing the real objects. Moreover, since his two eyes see the picture from slightly different angles, they see slightly different views, as in looking at a real object. This gives the picture a real appearance of depth."

This method is the only one known which gives true stereoscopic relief without the aid of an instrument immediately in front of the eyes. It is for this reason of greater interest in connection with a consideration of the

[1] U. S. Patents 1,579,974 and 1,351,508.

[2] U. S. Patents 1,150,374 and 1,260,682.

(*Continued on page* 41)

A New Disc Re-Synchronizer

By SAMUEL RUBIN*

IN disc reproduction difficulties arise when the film breaks and it is necessary to cut out or eliminate a part of it in order to repair the break; or when the reproducer or the needle which it carries skips or jumps some of the grooves of the sound record or continues to follow the same groove and "repeats." When either of these contingencies arise there is no way of continuing the synchronized reproduction of sight and sound, and the only thing that can be done is to discontinue the reproduction and start another machine loaded with the succeeding reel. There is no way of determining in such a situation the point at which the needle of the reproducer should be placed upon the record.

The principal object of the invention which I shall describe in succeeding paragraphs is to provide a means by which, in the event of the abovementioned occurrence, the sound record (disc), and the film may be resynchronized without any appreciable loss in time and without the elimination of any appreciable amount of the visual or audible record.

In the drawings: Fig. 1 is a diagrammatic view in elevation of a conventional motion picture projector and sound reproducing device.

Fig. 2 is a front elevation of a conventional form of intermittent film feeding mechanism used to move the film past the projection lens, and embodying a part of my device.

Fig. 3 is an end view of the said intermittent feeding mechanism embodying a part of my device.

Fig. 4 is a plan view of a fragment of a sound record, a location scale and supporting mechanism, and a part of the sound reproducing mechanism embodying a part of my invention.

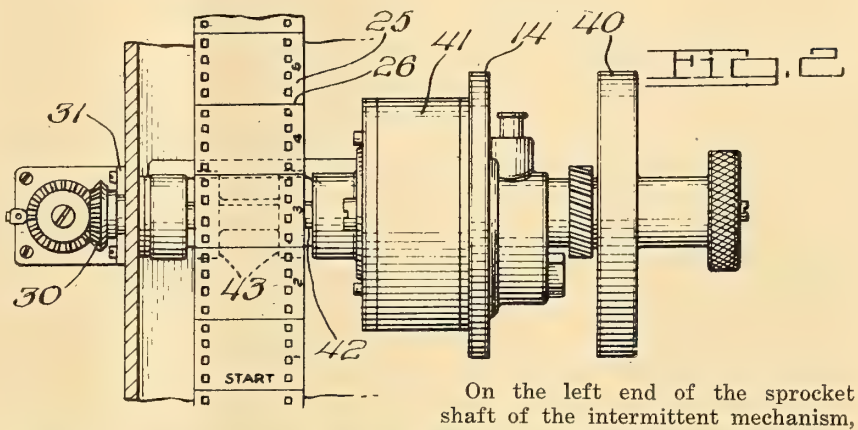


Fig. 2

Fig. 5 is an elevation of the view shown in Fig. 4.

In Fig. 1 the numeral 10 designates that part of the roll of film which has not been shown, and the numeral 13 indicates generally the position of the projection lens, and the numeral 15 indicates the position of the intermittent film moving mechanism shown in Fig. 2. The numeral 16 indicates the stand upon which the turntable 17 carrying the sound record 18 is mounted. The numeral 19 indicates the reproducer arm, the numeral 20 indicates the location scale bracket which forms a part of my device which will be later explained.

The film 25 indicated in Fig. 2 comprises a series of pictures separated by the lines 26, and having in each margin a series of apertures which are engaged by the sprockets of the sprocket wheels of the intermittent mechanism 14. As is well known, this mechanism operates to pull each picture or frame of the film before the projecting lens and to hold it there for the length of time necessary to project the picture onto the screen and then to pull it past the lens and pull the next succeeding frame into place.

On the left end of the sprocket shaft of the intermittent mechanism, as shown in Fig. 2, I have secured a bevel gear 30 and to the bearing which surrounds the left end of the shaft back of the bevel gear 30 I have secured a plate 31 extending at right angles to the plane of the shaft. Upon this plate 31 I have mounted a conventional counting device comprising a plurality of rolls each bearing numerals in series thereon which are mounted upon a shaft 32 extending longitudinally through the housing 33 and projecting from the housing adjacent the bevel gear 30. To the end of the counting machine shaft 32 I have secured a bevel gear 34 positioned and adapted to mesh with the bevel gear 30. One side of counting device housing 33 has a window or aperture 35 therein through which the numerals on the counting rolls are visible.

In operation, the balance wheel 40 which is keyed to a shaft of the intermittent mechanism is continuously rotating and carrying the shaft with it. The shaft which carries the balance wheel 40 terminates inside the box 41 and by means of a cam arrangement attached to it operates the sprocket shaft 42 which extends out the other side of the box 41 and carries the sprocket wheels 43. This mechanism is so arranged that the sprocket shaft 42, and sprocket wheels 43, by intermittent movement rotate once while the shaft upon which the balance wheel 40 is mounted rotates 4 times. This is also arranged to accord with the standard film which carries 16 pictures to the foot of film, and each movement of the shaft 42 and sprockets 43 is sufficient to move one frame of the film past a given point.

The construction and operation of the intermittent mechanism shown is conventional and well-known in the art and it is not believed necessary to go into further details concerning its construction and operation.

The counting mechanism contained in the housing 33, the construction

* Local Union No. 199, Detroit, Mich.

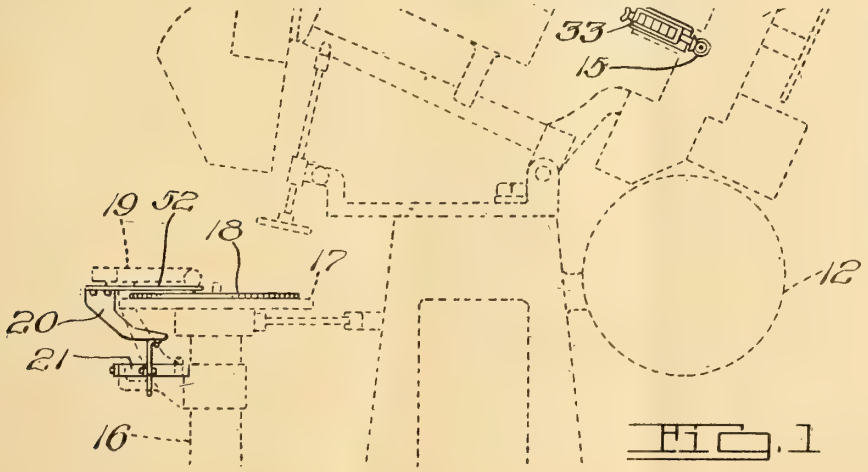


Fig. 1

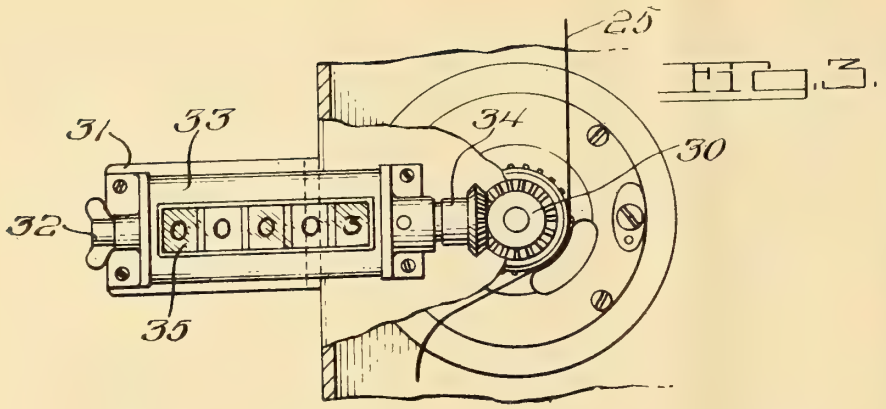


FIG. 3.

and operation of which is also conventional, is so arranged that each movement of the sprocket shaft 42 which carries the bevel gear 30 causes the shaft 32 of the counting device which carries the numeral rolls to record the passage of one frame of the film. In the form of counting device shown there are five numeral rolls which are capable of recording the passage of 99,999 frames of film. The usual length of the rolls of film is 1,000 feet or 16,000 frames. Therefore, by referring to the exhibited numerals of the counting device during any point in the projection of the roll of film it is possible to calculate accurately the number of frames of film which have passed the lens of the projector and the amount which remains to pass.

Referring to Fig. 4 which is a plan of a fragment of the sound record 18, the starting point is marked by the dot indicated by the small arrow near the central portion of the record, and the word "start" adjacent thereto. Secured to the scale bracket 20, and extending horizontally above the face of the record 18, is a plate arm upon which is supported a scale 52 which carries a graduated scale beginning at the inner end of the plate and progressing outwardly of the record and which carries markings which indicate by means of the arrows the starting point on the record 18 and the points marked by the dots on the record at which the sound corresponding with the beginning of the 400th, 800th, etc., frame of film will commence. Such scales may be made up for every size and type of record.

The reproducer arm carries the needle 50 which follows the grooves of the record and adjacent the needle pointer 51 which moves outwardly of the record with the needle 50 opposite the scale 52 and indicates by means of markings on the scale the progress of the needle 50 on the record.

It is preferable to indicate by dots or other means on the record points corresponding to the scale of indications, so that when desired the needle may be set upon any one of the dots corresponding with the scale indications. The bracket 20 may be slidably mounted upon the horizontal bar 21 which is attached to the turntable standard 16 so that it may be shifted to position the scale accurately relative to the record 18, and hinged as at 22, so that the scale may be tipped back to permit removal of the record. The records may be marked with dots as described.

It will be understood that the mechanism operating the turntable which carries the record 18 is synchronized with the mechanism operating the intermittent film moving device so that the reproduction of sound will coordinate with the visual action projected from the film.

The starting end of a reel of film is usually provided with a frame indicating the start, and a starting point is shown as indicated on the sound record.

In operation, the pulling of the frame of the film carrying the start indication past the lens by means of the sprockets 43 causes the counting device to register the numeral 1, indicating that one frame of the film has passed. When the projection machine is ready to pull the starting frame through, the needle 50 on the reproducer arm is set at the starting point on the record 18. The operation than commences and as the film passes through the projection machine the counting machine records the number of pictures or frames that have passed, and the needle on the reproducing arm follows the record in coordination with the passing motion picture film.

In the event of a break in the film above the sprockets 43 the projectionist immediately stops the machine and notes the number of frames recorded by the counting device. Ordinarily when such a break occurs, the projectionist cannot determine the point on the sound record 18 at which the needle 50 of the reproducer arm 19 should be placed to coordinate with the following frames of the film; thus, the only procedure left for him to follow is to repair the break and start again at the beginning of the film and the sound record, or to disconnect the reproducing arm from the sound record and complete the projection of the reel without the sound accompaniment.

Or, as sometimes happens, the film does not break but the needle on the reproducer arm skips or jumps or repeats some of the grooves on the record, and thereby throws the sound record out of coordination with the film. In such cases, the only procedure left is to start again at the beginning of the film and record or to disconnect the reproducing arm from the sound record and proceed to complete the reel of film without the sound accompaniment. Such procedure frequently annoys the audience.

By using my device, however, such annoyances and the accompanying trouble may be avoided. When the film breaks above the sprockets 43 the machine may be stopped. It will generally be impossible to stop the intermittent mechanism the moment the film breaks and consequently the number of frames recorded by the counting device will be greater than the number that has actually been projected. However, by consulting the footage numbers on the film the projectionist can quickly determine the number of frames to pull through, without operating the intermittent mechanism, to equal the number recorded on the counting device, or he may reverse the machine and turn the counting device back to the frame number above the break.

The film may then be again connected with the intermittent mechanism and the projection machine

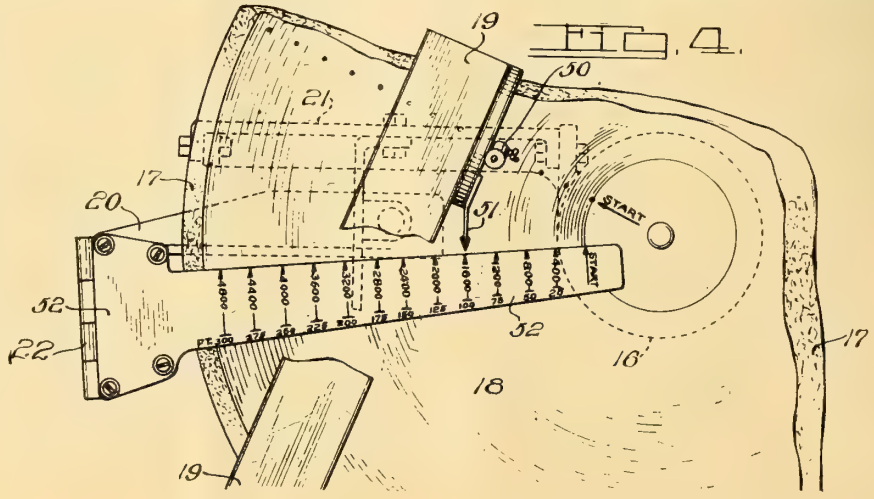


FIG. 4.

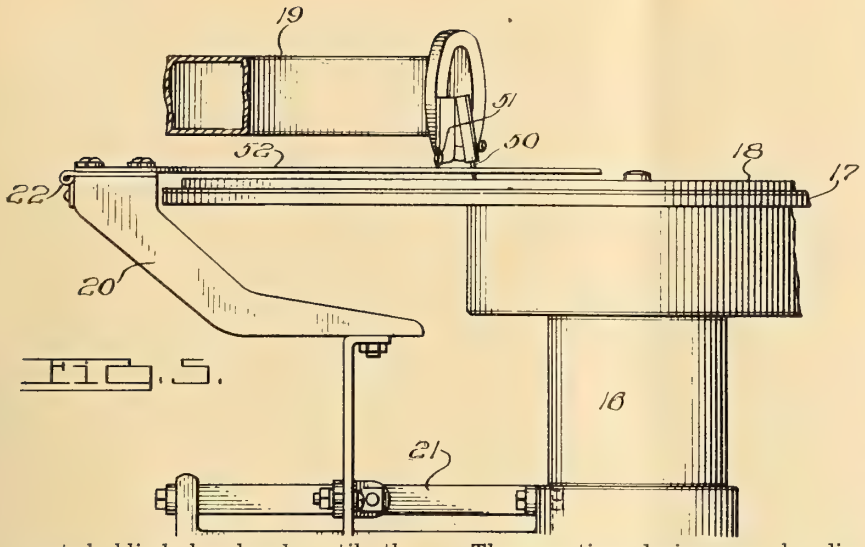


Fig. 5.

operated blind by hand until the number of frames recorded on the counting device coincides with a frame number indicated on the scale or record. The reproducer needle may then be placed on the record at the point indicated by the scale or dot as coinciding with the frame number showing on the counting device and the projection and sound reproduction continued. Such an operation requires only the elimination of a relatively small part of the film and record from projection, which omission will usually not be particularly noticed by the audience.

The counting device may be disregarded in such a situation if the projectionist prefers to determine the proper frame number to correspond with the record or scale indications by consulting the footage or frame numbers on the margin of the film; but more time will be consumed by such a procedure, especially where the synchronization between the sound record and film is destroyed on account of the reproducer jumping or repeating grooves as hereinafter explained.

When the needle 50 skips or jumps grooves in the sound record 18 the machine may be stopped, the number of frames which have passed through are shown by the counting device, and a sufficient additional number may then be run blind past the projection lens to make the recorded length of film correspond with the next highest frame number appearing on the scale 52 or on the record 18. The needle 50 of the reproducer arm 19 is then set on the record at the point indicated by the indicating arrow 51 in alignment with the proper mark on the scale 52, or at the proper mark on the record if the scale is not being used and the performance may then proceed.

The graduations on the scale 52 which are shown in the drawing are set as shown for convenience in explanation. It will be understood, however, that the intervals between points will not in actual practice, represent equal numbers of frames owing to the increasing length of the grooves as the needle approaches the outer edge of the record, and that the distance between the points on the scale may be shortened to correspond with the amount of film unrolled while the needle 50 is passing once around the record.

It will be obvious that various changes may be made in the specific arrangement, combination, and construction of the various parts of this improved device without departing from the spirit of the invention.

Circuits for Various P. E. Cell Applications

By A. J. McMASTER
G-M Laboratories, Inc.

THE current from all types of photoelectric cells is necessarily extremely small, i. e., of the order of microamperes. To utilize such minute currents for measurement or control purposes, two classes of equipment are available. The cell current itself may be measured by means of low range microammeters, by reflecting mirror galvanometers, or by means of various types of electrometers. A simple photometer circuit in which such a measuring instrument is used is shown in Figure 1. This circuit can be used for the photometry of lamps, measurement of reflection, absorptive and transmissive power of materials, and for many other purposes. It is also possible to design extremely sensitive relays with which local circuits can be controlled to operate in the series circuit of Figure 1. However, such instruments are very expensive, and their use is not considered to be entirely satisfactory.

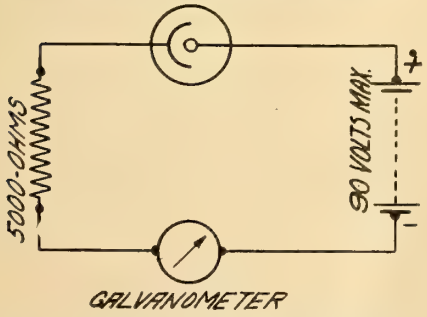


Fig. 1—Simple photometer circuit, for comparing light intensities, measurement of relative transmissive power, reflective power, etc.

In Figure 2 is shown an optical arrangement which may be used in studying the properties of materials in conjunction with the circuit of Figure 1.

When it is undesirable to use one of the very sensitive current measuring instruments required in the simple series circuit, or where a relay is required to initiate an operation by controlling a local circuit, one or more stages of vacuum tube amplification must be used with the cell. In Figure 3 a one stage direct coupled amplifier is shown with both a milliammeter and an electromagnetic relay in the plate circuit of the three electrode tube. With the milliammeter, the cell and amplifier may be used as a light-measuring instrument in the same manner that the circuit of Figure 1 can be used. By the proper selection of tube and circuit constants, a linear response characteristic will be obtained over a range of light intensities.

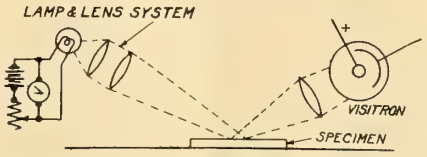


Fig. 2—Optical arrangement of lamp and cell used in measuring properties of various materials and for sorting, grading, counting and inspection purposes

With the electromagnetic relay in the plate circuit, so adjusted to operate on a definite current margin, this one stage amplifier circuit is used to control small lamps or power relays

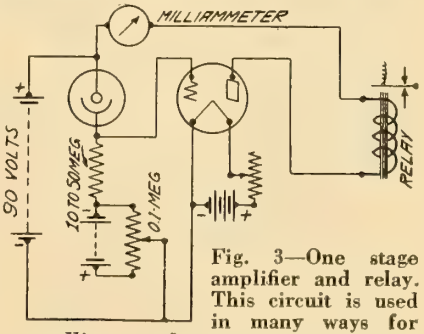


Fig. 3—One stage amplifier and relay. This circuit is used in many ways for controlling an electric circuit by means of light and for the measurement of light flux or illumination.

when the light on the Visitron cell changes by a pre-determined amount. The uses for such an "optical relay" are practically unlimited. Some of the obvious applications are in the control of artificial illumination, and in the operation of timing and counting devices in which the control medium is but a beam of light.

The sorting of piece parts, examination of polished surfaces for flaws, counting of painted articles, control of machines using stock of variable length, operation of safety devices on elevators and hundreds of other applications are entirely practical with this type of circuit or modification thereof. For many purposes the optical system of Figure 2 can also be used with the circuit of Figure 3.

Such amplifier circuits can be designed to operate on a. c. or d. c. supply lines. As the light signal is generally of the non-oscillatory type —i. e., the changes are of very low frequency—it is necessary to use continuous current or direct coupled amplification. In such circuits, it is impossible to use grid condensers resulting in the necessity for separate

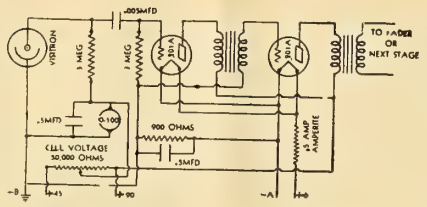


Fig. 4—Preliminary amplifier used with Visitron cells for sound picture work

"A" and "B" batteries or high grid bias potentials in multi-stage circuits. To obviate this difficulty it is customary in some cases to introduce an audio frequency into the circuit electrically or optically by means of a rotating sector or other means. In such an arrangement, the amplifier may be of the ordinary resistance—condenser or transformer coupled types, one of which is shown in Figure 4.

In talking motion picture work, it is customary to use a preliminary or "head" amplifier of the type shown in Figure 4. The output of this amplifier may be attenuated through the fader and then connected to the power amplifier of three or more stages terminating in power tubes and theatre speakers. In designing such amplifiers it is desirable to provide sufficient voltage gain that the photoelectric cell may be operated at an output level below its maximum capacity.

When two sound projectors and two preliminary amplifiers are to be used with one fader and one power amplifier, it is customary to match the output of the cell in each projector to give the same output to the fader. The recommended method in the case of gas-filled type A cells is to adjust the cell voltage by means of a potentiometer. In all cases, the cell voltage should be made as low as possible to obtain the most satisfactory results, and the maximum cell life.

When Type AV vacuum cells are used with an amplifier it is not possible to attenuate the cell output satisfactorily by decreasing the applied voltage. In this case it is necessary to provide an interstage potentiometer by means of which the voltage signal may be properly controlled. An alternative method is to control the intensity of the light source.

More on Lens Wheel Projector

MANY inquiries were received as a result of the article, "Revolving Lens Wheel Projector," which appeared in the August issue. These inquiries were forwarded Mr. A. J. Holman, inventor of this projector, who, while extremely busy at present, presents a prepared statement which he uses to answer the most commonly asked questions on his development. Several inquiries in the group will be answered by Mr. Holman in detail when he begins the presentation in these columns of a series of articles intended to explain in detailed form several points of the mechanism. His communication follows:

"I am very glad to receive the inquiries which you so kindly forwarded to me subsequent to the appearance in your publication of a description of my revolving lens wheel projector. I regret that I have not the time just at present to answer in detailed form some of the questions in this group, but I shall essay this when I submit to you the series of articles you arranged for. A prepared statement which I made up some time ago covers fairly well a majority of the questions asked about my projector; and I shall beg your indulgence to use this for the present. At a later date I shall be glad to go into a more detailed explanation of the points involved" (Statement follows):

Cleaning of Lenses

"In regard to keeping the lens wheel clean, it will be of interest to know that these lenses require cleaning perhaps once every three or four months. Centrifugal force and the air currents within the enclosing case provide a natural cleaning effect, hence the projectionist has little to do in this respect.

Use Lenses, Not Mirrors

"It must be remembered that these are lenses and not mirrors. With reasonable care, lens wheels should not deteriorate appreciably in five years' service, due to scratching of the lenses incident to cleaning.

"The point with regard to securing the required accuracy in commercial construction of lens wheels is well taken. Just how this problem has been solved is fully described in an article appearing in the June, 1930, issue of the *S. M. P. E. Journal*, pages 623-635. I have perfected a lens grinding and polishing machine which produces exactly matched lenses in quantities at low cost.

"Regarding the light transmitting efficiency of the condenser and objective system, there is nothing to choose between our projector and the best intermittent projectors. Our present mask system cuts off about the same amount of light as does the shutter of the intermittent projector, but we have recently devised a means for saving this heretofore wasted light, thereby increasing the light transmitting efficiency of our system about 100 per cent.

Reduction of Heat

"Our condenser system has many advantages, one of the most important being a much cooler spot, due to the greatly reduced light concentration.

"There is no doubt but what the elimination of flicker, both visible and invisible, reduces eye strain, hence it is not at all surprising that our projected picture may be viewed for long periods without producing fatigue or a sensitive state of the eyes. After witnessing direct side-by-side comparison tests, experts, on two occasions, have stated that the performance of our projector, as regards definition, steadiness and illumination, is the equal of the best results obtainable with the latest new intermittent machine.

"Having equalled the best in these respects, our system of projection has in addition all the well recognized advantages of continuous projection and none of the difficulties."

Contribution to the Art

Some expert has told us that speech energy extends from a frequency of 60 cycles to above 6,000, with an average of about 200 cycles. The vowel sounds carry most of the energy of speech and their important frequencies lie below 3,000 cycles. The consonants are the characteristic quips and quirks with which the syllables begin and end, weak in energy but important to intelligibility. In frequency they are rather high, some involving vibrations attaining to a frequency of 6,000 cycles or even higher.

The speech energy output of the normal voice has been found to be at the rate of about 125 ergs per second, and computations reveal that if we could have a million persons talking steadily, and were able to convert the energy of their voice vibrations into heat, these people would have to talk for an hour and a half to produce enough heat to make a cup of tea, and yet we are charged with being the sole purveyors of "hot air!"—Frank H. Vizetelly in *Atlantic Monthly* for August.

Essential Points on Theatre Acoustics

By PAUL E. SABINE, PH.D.

In Collaboration with Acoustical Division, Western Felt Works

MOST motion picture theatres now in use were built originally for the "silent drama." Little attention was paid to their acoustical properties. The introduction of sound motion pictures has made good acoustics an essential requirement of motion picture theatres. As a result many theatre managers find it necessary to correct the poor acoustic conditions that now exist. Each theatre presents a particular problem which calls for detailed study, and in the case of large theatres where the problem is particularly difficult, the theatre owners should obtain competent advice from a recognized authority on the subject.

Acoustical difficulties are largely due to what is known as excessive reverberation. To know what is meant by reverberation it is only necessary to step into an empty theatre and speak a single syllable in a loud tone of voice. It will be noted that the sound is prolonged for a considerable length of time. This prolongation of sound is known as reverberation. When extreme, prolongation of each syllable causes successive syllables to overlap, making it difficult and sometimes impossible to understand.

Cause of Reverberation

Reverberation is due to the reflection back and forth from walls and ceilings and floors of the sound waves. Tests show that an ordinary wall or ceiling reflects about 97 per cent of sound energy that strikes it, only 3 per cent. of the energy being absorbed. It is easy to see that if there is nothing but surfaces of this kind for the sound to strike, it will take a large number of reflections for sound energy to be dissipated to the point of inaudibility. In other words, reverberation, the cause of poor acoustics, is due to excessive reflection and insufficient absorption of sound by the interior surfaces of the room.

Soft, fibrous, porous materials, such as draperies, carpets, the upholstering of seats and the clothing of the audience absorb sound much more strongly than do hard non-porous materials. All absorbent materials in a room contribute to what is called its "total absorbing power." Increasing the total absorbing power reduces the reverberation in a room. In some cases these natural factors are to keep reverberation from being excessive.

In other cases, particularly in rooms in which no attention was paid to acoustics in design, the absorption is too small and the reverberation is correspondingly great. Sometimes where the average audience is much smaller than the total seating capacity a theatre may be satisfactory when all the seats are filled, and acoustically poor when only a small audience is present.

The remedy in such cases is to install a highly sound-absorbent material in sufficient quantity to bring the reverberation time down to what it should be. Precise, determination of the reverberation time of an existing room, and the treatment necessary for its correction, requires a detailed study of the plans. But the rules set forth in the following will be found in a large percentage of cases to be sufficiently accurate for all practical purposes, and are such that the theatre man can determine for himself whether or not he should invest in acoustical treatment and, if so, how much and where it should be applied.

Acoustic Treatment Necessary

That there is a great need for sound treatment has been forcibly brought to the attention of the motion picture industry.

With the advent of sound pictures it was found that many houses could not possibly handle sound pictures, without first installing sound absorbing material to correct the acoustics.

The theatre industry had to expedite their preparation for sound and talking pictures for the following reasons:

A: Almost 100 per cent of the pictures now being made by the producers are sound or talkies.

B: The millions of dollars spent on the development of the radio has taught the theatre-going public to appreciate tone quality in sound pictures. The public will not pay to hear poor sound projection.

C: The small house is made an equal competitor of the large house by having correct sound conditions.

D: Theatres which have properly equipped themselves for sound have shown marked increases in percentage of attendance.

E: Theatregoers will drive miles to enjoy a good sound or talking picture properly projected in a house where acoustics are good.

F: A good talking picture projected in a house acoustically unsuited to sound reception is similar to weak voices, untrained amateurs trying to compete with high class professionals.

G: The exhibitor seldom realizes how faulty his own reproduction of sound is.

Rigid rules can be issued or quiet signs can be posted. These are all subject to the whims of human element and are seldom rigidly enforced. Where noise exists it is necessary on the part of everyone to make more noise so that they can be understood. Unless something is done to quiet the necessary noise at its origin, there is soon an accumulation of both nec-

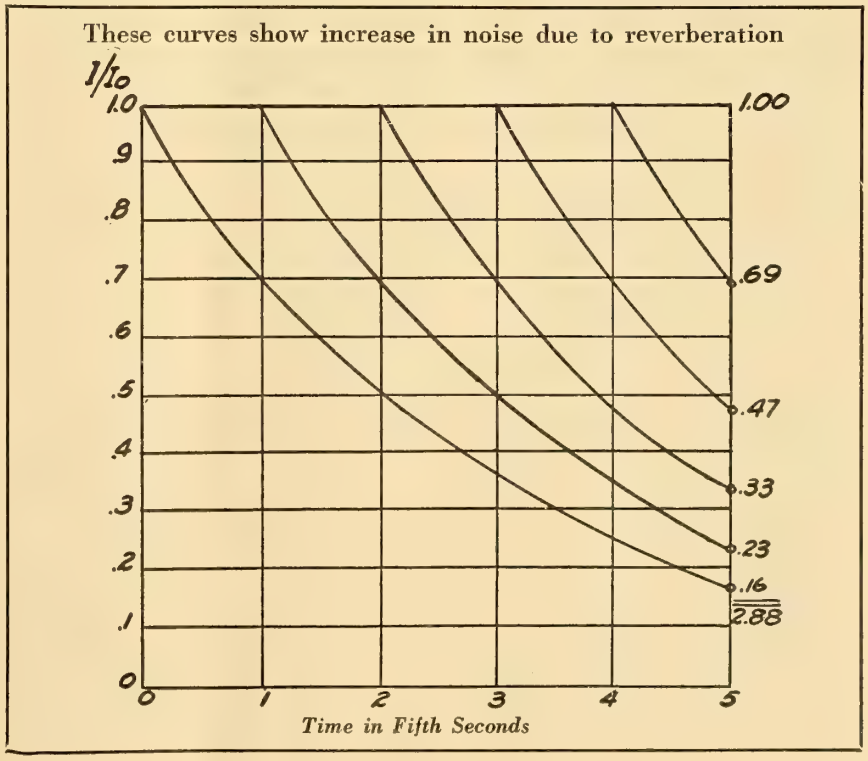


TABLE 1

Volume of Room in Cubic Feet	Acceptable Limits of Reverberation Time in Seconds: Half Audience	Maximum Audience	Volume of Room in Cubic Feet	Acceptable Limits of Reverberation Time in Seconds: Half Audience	Maximum Audience
10,000	0.9-1.2	0.6-0.8	400,000	2.1-2.3	1.7-2.0
25,000	1.0-1.3	.8-1.1	600,000	2.3-2.6	1.8-2.2
50,000	1.2-1.5	.9-1.3	800,000	2.5-2.8	1.9-2.3
100,000	1.5-1.8	1.2-1.5	1,000,000	2.6-2.9	2.1-2.5
200,000	1.8-2.0	1.4-1.7			

essary and unnecessary noise that becomes unbearable. This is shown in the chart shown herewith.

Sound Wave Characteristics

Sound waves travel by air 1,100 feet per second. Sound generated in a room proceeds outward in spherical waves from the source to the walls, where it is reflected, absorbed and transmitted. The reflecting sound proceeds to a second wall where it is again reflected, absorbed and transmitted, and so on, experiencing from 200 to 300 reflections to an average sound. The greater the dimensions of the house, the more prolonged will be the reverberations, other things being equal.

Reverberation time of a room, house or auditorium, is the time required for sound of specified intensity to die away to inaudibility. Actual calculation rather than experiment must be employed to determine the reverberation time of each room. The method of making this calculation will be explained later.

If the walls of the room are covered with some highly sound-absorbent material, only a small number of reflections may suffice to destroy the sound. Such a room is acoustically "dead" and undesirable. A little reverberation is necessary to satisfy our established tastes and auditory habit, and the desired amount of reverberation is found by experiment to increase with the size of the auditorium.

Experience with a number of existing auditoriums of acceptable acoustic quality makes possible the formulation of Table I shown herewith, on which the acceptable limits of the standard reverberation time are expressed for rooms of different volume.

The limits given in the table are not to be regarded as rigid. Auditoriums are known which exceed these limits in either direction by several tenths of a second and yet are fairly satisfactory quality. However, in planning a new auditorium it should be the aim to strike the average of the range given.

As a result of investigations we have a formula giving the reverberation time of a room. Let

t=reverberation time in seconds,

V=volume of room in cubic feet,

A="total absorption" of the room (explained below).

Then the following relation holds:

$$t = \frac{0.05 \times V}{A}$$

The only point that needs explanation in this formula is the quantity A.

Different materials differ considerably in their absorbing powers for sound. The most complete absorber known is an open window. It is theoretically possible that a small amount of sound may be sent back by diffraction from the edges of the window, but this quantity is so small that it is permissible to say that an open window is a perfect absorber. In other words, if it may be said that an open window absorbs (or transmits) all the sound that falls upon it. Its coefficient of absorption is unity, while that of ½" Westfelt is 0.34.

In like manner, every substance may be said to have its own absorption coefficient. This constant has been measured by a known authority for a number of common materials, and workers have extended the list. If now, we take each surface exposed to sound in the roof, and multiply it by its absorption coefficient, then the sum of these co-efficients for all the surface will be the quantity A.

(*To be continued*)

Projection a Specialized Art

INDICATIVE of what is meant by the statement that projection is a specialized art is the following newspaper clipping which was submitted for reprinting from the headquarters of the Projection Advisory Council. The incident which forms the basis for this news story drives home the argument of friends of projectionists that a real worker in the art must be more than a mere mechanic, that he must in fact be inoculated with the showmanship virus. The particular point of view expressed in this contribution has been presented in many words and many forms on numerous occasions, but never more effectively, and it is with real pleasure that we reprint it here.

Editor, MOTION PICTURE PROJECTIONIST. Sir:

Enclosed you will find an item from *The Evening Sentinel* Ansonia, Connecticut. While the accident was a serious one and John Griffiths, Jr., has my sincere sympathy, it is not solely for this reason that I call your attention to the matter. The particular interest of the item is in the two concluding paragraphs and especially in the four concluding lines. Reading: "the plucky father who upheld the tradition of the theatrical profession that *no matter what happens, the show must go on.*"

In "Projection A Specialized Art" issued about a year ago by the Projection Advisory Council, it was pointed out that the projectionist must be more than a technician. A good technician may have a knowledge of electricity, optics and mechanics, which would enable him to qualify as a first class operator. Until, however, he has had long experience in the theatrical field and has become a showman, he will not have become a real projectionist. It is this unique combination of a technical training with the development of his artistic side, which really makes a *projectionist.*

The article from the *Sentinel* follows:

John Griffiths, jr., projectionist at the Capitol theater who received an electrical shock yesterday afternoon, had so far recovered this morning that he was able to leave the Griffin hospital. It is believed that Mr. Griffiths will fully recover from his experience.

He had a close call however. Trouble was experienced in the theater yesterday afternoon when the electric current failed and Mr. Griffiths, who was in the projection room with his father, John Griffiths, chief projectionist, left the booth to test the wires. While thus engaged the current returned and Mr. Griffiths received a severe shock.

He did not receive the full voltage of the moving picture wires, which is high, but was seriously affected. He managed to get back to the projection booth where he collapsed. Mr. Griffiths was unconscious when taken to the Griffin hospital, but later revived and improved so rapidly that this morning he was able to go to his home.

Father Stayed at Post

Mr. Griffiths, senior, while deeply concerned over the condition of his son, remained at his post. The performance was resumed, although the father, knowing his son was unconscious at the hospital, was beset with fears and doubts.

People who attended the theater yesterday afternoon were unaware of the dramatic incident on the top floor of the playhouse or of the plucky father who upheld the tradition of the theatrical profession, that "no matter what happens, the show must go on."

The Engineer to the Projectionist:—

By James J. Finn

READERS of this publication will recall the hard fight waged in these columns for the right of projectionists to exercise their natural curiosity and to bend every effort to familiarize themselves with details of the particular sound reproducing system which they are using. The efforts of this publication in this direction bore fruit, for conditions in this respect at present, with both manufacturers and projectionists cooperating with each other for the common good, are unparalleled in the motion picture business. Never has there been such close contact maintained, such good fellowship established between the maker and the user of projection equipment as at present. And this obviously is a good thing, a development to be nurtured and furthered in every direction.

In certain quarters of the industry, however, there still exists that diehard feeling that projectionists should accept whatever equipment is handed them and without further comment proceed to operate it. It is required, of course, that the projectionist deliver 100% efficiency with the equipment—whether he understands the details of its mechanism or not. This little cotérie who advocate the retention of the old-style method of marketing and servicing projection equipment, give the impression that all equipment, even after it is installed in the projection room, is as much a secret as when it was under development in the manufacturer's factory, and that a projectionist has but to *operate* it and not *design* it. Cooperation to this small group consists in having the projectionist do not as he thinks best but as he is told. This surely is not a healthy condition.

Equipment Proving Ground

Granted that the average projectionist is not an "engineer," nor is he to be considered as equally well-versed in the sound picture art as the laboratory technician who is responsible for contributions to advancements in design, assembly and accuracy of the equipments; nevertheless, the writer reiterates at this time that in the projection room the projectionist is supreme, and there is no group of men to be found today who can go in and duplicate his work in every particular. Any number of manufacturers have told the writer that the best test of any new piece of equipment is to be had from a thirty-day test in a number of projection rooms. The suggestions for improvement which result from such trial runs are at once a tribute to the manufacturer's foresight in arranging for the tests and to the projectionist's acumen in his work. This is fact, not fancy, and may be verified by inquiry to any manufacturer of projection equipment.

I have seen any number of projection appliances that held great promise in the laboratory, that in theory and preliminary experiment shaped up as fine accessories to the projection art; and I have seen these same appliances fade from the equipment picture after a short trial in the projection room under actual operating conditions.

There is absolutely nothing that goes into a projection room that should be a mystery to the projectionist. He should understand the whys and wherefores of every bit of equipment in his room; and if he doesn't, he is fooling himself, cheating his employer, and betraying his Local Union which placed him on the job.

In connection with sound equipments, the rather general impression prevails that projectionists should take it as it comes, trust in God, and proceed to learn the operating principles by rote and without concern to the reasons for their operating moves. This publication is absolutely opposed to any such theory, and, further, it maintains that no projectionist or group of projectionists should be exposed to such propaganda.

I cite at this time certain excerpts from the remarks of a sound picture company service engineer before a Florida Local Union as indicative of the general tone of such propaganda. The portions referring to cooperation between projectionist and engineer are fine—great stuff; but the implication that the projectionist should stifle his natural inquisitiveness is not so good. These remarks follow:

Engineer to Projectionist

"I shall say a few words as to our relationship in general, yours and mine.

"What is to you the strongest, the most powerful word in the dictionary? I believe that you will agree with me that it is the word 'FAITH.' In everything that we do it is FAITH, FAITH. If you were to operate an elevator of some building you would not necessarily inquire into the structure of that particular building, that particular elevator shaft or of that particular elevator. You have faith in their proper design and construction. You are primarily interested in the procedure for the proper operation of your elevator. That is the job on hand. That is your assigned duty.

"When you go into your auto you have faith that the engineers have so designed and constructed it for strength, durability, speed and endurance that with the proper amount of lubrication, gas and electricity (the spark) plus your piloting that you 'get there.' You do not delve into the finer parts of your auto constantly to experiment. You do not fool with it as long as it is giving you service. You do not ask why and how and what the relationship of each part of the car is to the other that makes it run. You accept certain established axioms and definite facts. You don't worry about a thing but oil, gas—and the girl. You have faith in the soundness and construction of the car. You have faith in the designers of the engine. You have faith in your garage or service man, and lastly you have faith in yourself, your driving, because you are following what has been found from long established practice the best method and procedure for handling the car and yourself.

"And so it should be with your sound equipment. Carry on what has been found to be the best practice for its proper functioning. Don't permit yourselves to worry needlessly as to the whys and wherefores of its construction. The general principles—yes—but not the minute details. Don't experiment with your sound equipment, because you cannot be expected to improve on or compete with the laboratories any more than you could or would with the steel structural designers and builders of your skyscraper, your elevator shaft, your elevator or of your automobile manufacturer, all of whom are spending millions annually and have hundreds of engineers to keep your equipment at its peak and abreast of the times. Have a little faith. Take something for granted. Follow the established directions and instructions. Use good judgment in your driving and piloting. As with your car, don't demand the impossible even if it is made of iron. Watch and see and hear everything when at the wheel. If you have lubricated correctly; if your mechanism is clean; if your batteries are up—permit me to say, 'You should worry.'

"For your daily auto outings you have little to watch, but imagine yourself taking a long trip once a week. No matter how good your 'boat' or car runs you give it special attention, a good cleaning inside and out. Inside for smoothness and better functioning of your engine and outside for your personal pride. Your equipment now has a week's trip ahead—I, personally, have not a kick to make anywhere as to the condition of your sound equipment—but as you know there is always a little room for improvement. Watch the inside and outside of your projection heads, of your motors, of your batteries, of your booths. You know how you judge the other fellow's wife—by her housekeeping. The mechanic by his shop and his tools.

"In conclusion:—Have a little faith in your equipment. A little faith as to the whys and the wherefores. A little faith in your engineer's advice or suggestions. He in turn accepts his daily instructions on the same principle. Please accept what the

(*Continued on page* 44)

As The EDITOR Sees IT

¶ *Stereoscopic Motion Pictures*

A MUCH-TALKED-ABOUT objective of the motion picture industry some four or five years ago was the perfection of a process which would result in stereoscopic motion pictures—the conquering of a problem which has piqued the curiosity and occupied the attention of some of the best brains in the world. Sound pictures have swept over the industry and have been absorbed by it, or have absorbed it, according to one's point of view, but stereoscopic motion pictures have defied all efforts to master them. And not because the attacks to unlock their secrets haven't been numerous and arduous, for really serious work on the project has been going on for fifty years or more.

We wish at this time to direct attention to the article "Three-Dimensional Vision," by Hugo Lateltin, which appears elsewhere in this issue. Ths article, the work of a projectionist member of Local Union No. 306 in New York City, is the result of considerable thought and not a little research work on the part of Mr. Lateltin over a period of months. It is an excellent piece of work, one that we are proud to present and prouder still to have had contributed by a projectionist. It merely goes to prove what we have always maintained—that much splendid material is available from members of the craft if they but would essay its preparation.

The title of Mr. Lateltin's article is, to us, indicative of the reason for so many failures at solution of this problem. It is significant that he veered away from the ready-made title of "Stereoscopic Motion Pictures," or "The Third Dimension in Motion Pictures," and the like. Instead he deliberately chose "Third-Dimensional Vision," for the reason that this title adequately expresses the content of his remarks, and, more important, it points the way to future research in the *physical* rather than in *mechanical* field. In this we are entirely in accord with Mr. Lateltin: the problem will never be solved until the exact *physical* process of seeing is throughly understood. Mechanical contrivances designed to solve this problem will ever be useless until the definite requirements of the physical (the eye) are known.

¶ *How About Your Projection Room?*

FALL with its promise of winter will soon be here. Now is the time to put things in the projection room in order, to check carefully our equipment, to order spare parts, to have everything in our projection rooms in ship-shape fashion. Now is the time to ask ourselves whether we are ready for the long winter grind, the season when our equipments should begin to pay dividends in good projection in return for the money that was spent on them. The best equipment will not stand up under abuse—or neglect. Do that long-delayed job of a general check-up now. Don't be afraid to putter into every part of your projector—it not only will not bite you but will run all the smoother for your inquisitiveness. Check your sound system thoroughly; see that you have ample spares. Is the screen clean?

And, incidently, you might examine your conscience and ascertain if you still have that penchant for mutilating film: punch marks—clips—dirty, oily, prints—reckless rewinding. This item should have first consideration.

¶ *Wages and "The Ability to Pay"*

A FEW weeks back we mentioned the impending wage scale negotiations and voiced the opinion that the end of September would be reached without any untoward disturbances as a result thereof. This observation has thus far been proven accurate, for in all sections the preliminary meetings between theatre owners and projectionists have been held in an atmosphere of mutual cooperation and trust, a commendable effort on the part of each to see and understand the other's problems and a readiness to recede from a too far advanced position in order to smooth the way for a speedy settlement.

But there has been one phase of the negotiations with which we do not even pretend to be in sympathy and that the recurrent references on the part of exhibitor representatives and in certain quarters of the trade press to "the ability of exhibitors to pay an increased wage." This phrase immediately attracted our attention, and we have since been trying to figure out just how this factor assumed the importance of a pivotal point in a wage scale discussion. We are not so naive as to think that there will be no compromise, no hedging, and no trading on the part of the negotiators; but we cannot, no matter how long we ponder the matter, justify the present pivotal importance of the exhibitors' "ability to pay."

Are the salaries of producers, of directors, of actors and actresses, of dancing masters, of wardrobe mistresses, to mention only a few of the motion picture workers—are the salaries of these based on the employers' ability to pay or are they based on what the respective worker can get? The answer to the first section is simple:—"No." But, is the probable reply, these people are artists . . . Artists in the sense that theirs is a specialized field of endeavor, a long hard study, a life work? If the answer be yes, then we hasten to ask what can be more specialized than a trade, the trade of projection work in theatres?

It would be futile and a waste of space further to prolong this discussion. Before closing we wish to say that the bromidic reference to the law of supply and demand would be silly in this case. We have been all over that ground. What we want to say is that a sensible wage scale discussion should be concerned with the fixing of a fair price for a certain quantity of work—no more and no less. "Ability to pay" is suitable as a rather high-sounding phrase smacking of advanced economics but it simply has no place in a wage scale negotiation.

Photo-Electric Phenomena

By H. L. HALTERMANN*

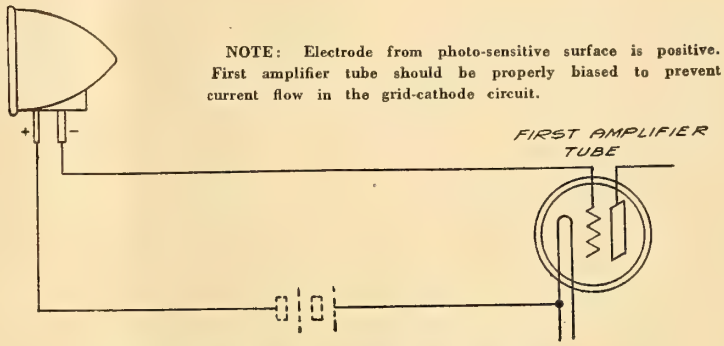
PHOTO-ELECTRICITY refers to the science and arrangements whereby electrical circuits are controlled by light impulses. The development of this Art is the most significant contribution of science to industry since the perfection of the vacuum tube. As far back as 1887 Hertz observed that the passage of a spark between two terminals of different potentials was greatly facilitated by the presence of the ultra violet ray which was produced from another spark in close proximity to the spark gap observed. Great interest was aroused on the part of scientists and in 1888 Hallwachs discovered that certain metals having a negative charge on their surface lost that charge in the presence of ultra violet light.

The science progressed slowly until the fundamental theories and major principles of the photo-electric effect inherent in certain types of metals were developed and established by Elester and Geitel, who practically completed their work by 1905.

Limitations in further development were imposed due to the fact that the currents, obtainable by placing a negatively charged cathode and a positively charged anode in an electrical circuit subjected to light of various wave lengths were far too small to apply to any electrical device then known. In fact, they could be measured only with the extremely delicate instruments used to determine the presence of minute charges or quantities of electricity.

Vacuum Tube Aided

The development of the thermionic, or vacuum tube, provided the first means of amplifying these minute currents or changes in potential resulting from the photo-electric effect on certain metals. This made possible the magnification of these small changes of electricity and caused a potent interest in the development of the present day photo-electric cell.



Static circuit, using unmodulated light source

It is needless to say that during this development great strides have been made, so that it is no longer necessary to confine ourselves to the ultra violet region of the spectrum. Light of almost any wave length, and particularly "white" light, may be used to produce the photo-electric effect (change of potential and current), in a photo-electric cell.

Light Sensitive Metals

Metals which exhibit the photo-electric effect to the greatest degree are *Sodium, Potassium, Rubidium, Caesium, Lithium, Strontium* and *Barium.* Of these, *Sodium, Potassium* and *Caesium* are the ones most universally used at the present time.

Coincident with the development of the photo-electric effect, the phenomena of photo-conductivity had been observed and investigations made to determine its practical worth.

Selenium was found to be photo-conductive; this means that the resistance offered to the passage of an applied current through this mineral changed with varying intensities of light which were directed upon it. The rate at which this change of resistance takes place was found to be very slow. As a result, in fields where light of high frequencies are met the selenium cell has been discarded.

Reverting for a moment to the year 1899, we find that a physicist by the name of C. Schmidt in Germany observed that crystals of *Cuprite* (cuprous oxide), used as electrodes in a solution of sodium hydroxide became more positive when exposed to light. To our knowledge, this observation constitutes the first application of a liquid to a photo-sensitive substance.

The past few years have seen an extraordinary increase in commercial applications of the photo-electric principle.

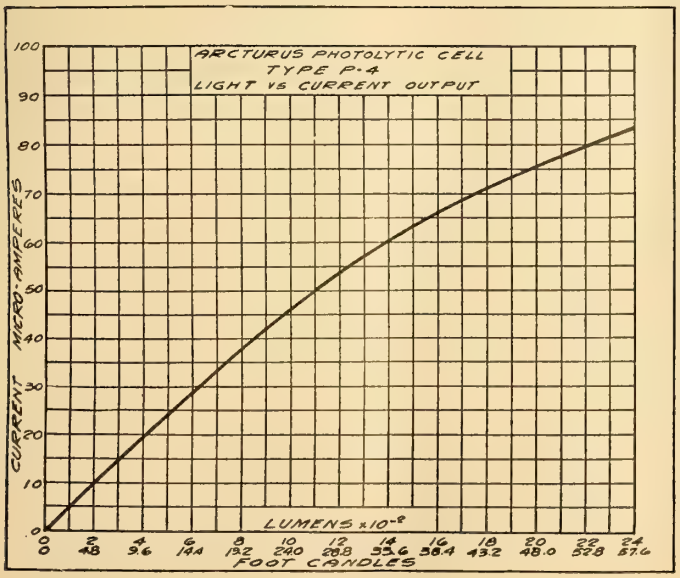
Recent Developments

Talking motion pictures established the first commercial market for photo-electric cells; signal systems, recording systems, and many types of checking equipment make the photo-electric unit an important industrial device; burglar alarm systems and smoke detection units confirm the photo-cell as a positive safety device; accurate medicinal analysis stamps the photo-cell as an important contribution to the welfare of mankind.

Although the present day vacuum and gas type photo-electric cell has been brought to a point of practical application there still exists a great opportunity for improvement.

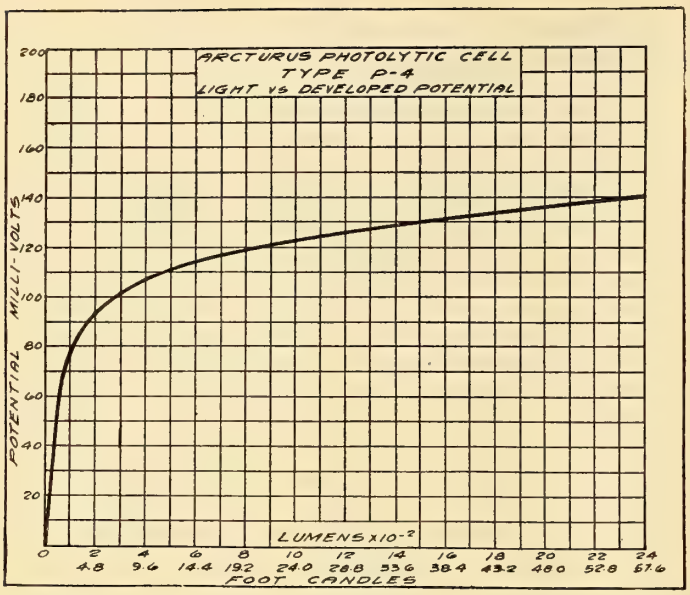
While the frequency response in the vacuum type of photo-electric cell is excellent, unfortunately its sensitivity, or output, is very low.

To overcome this lack of sensitivity, small amounts of gas of an ionizing nature are introduced to reduce the



Graph indicating the measure of the static sensitivity in current versus light

* Photo-Electric Division, Arcturus Radio Tube Co.



Graph of output potential developed under varying intensities of light. Steep slope of curve denotes extreme sensitivity to minute increments of light of small intensity

resistance offered to the passage of negative electrons from the photo-sensitive surface to the collecting ring or anode. While the introduction of this gas succeeds in increasing the sensitivity of the photo-electric cell, the frequency response characteristic is altered. Although both the high and low frequencies are increased, the response is not uniform, as the low frequencies are increased in much greater proportion than are the high frequencies.

Limitations of sensitivity in the pure vacuum type of photo-electric cell, without gas, practically exclude it from anything more than a laboratory experiment and the gas-filled photo-electric cell is the type most universally used.

Disadvantages of Vacuum-Type

Even this latter type is characterized by certain disadvantages, such as:

1. *Lack of Uniform Frequency Response.*

2. *Necessity of Using a Polarizing or Ionizing Voltage* to produce the electric field between the photo-sensitive surface (cathode) and collecting ring (anode). For greatest sensitivity this polarizing voltage must be adjusted to a very critical point, and this point will vary with the length of time a cell is in operation. A voltage exceeding this critical point in the most minute degree will cause the gas in the photo-electric cell to ionize, thereby permitting considerable current to flow through its circuit and damage the photo-sensitive surface.

3. *Lack of Uniformity.*

The coating of photo-sensitive material is microscopically thin and naturally each cell will vary in characteristics as the thickness in coating varies. Consequently, it is accepted in practice that different cells will have individual characteristics. In fact, it is found that the sensitivity of the photo-sensitive material in an individual cell will often vary over different points on its surface. The variation in substituting one cell for another necessitates readjustment of the amplifying system.

4. *High Coupling Impedance.*

In order to obtain sufficient sensitivity at minimum distortion through the gas cell it requires a coupling impedance between two million and three million ohms. This high impedance is subject to inductive interference such as that offered by any alternating current or the presence of a charged body and reproduces it together with the signal to be amplified, thus producing distortion in the output circuit.

5. *Microphonism.*

Due to the fragile construction of the wire elements within the glass bulb and the high impedance coupling there is an attendant reproduction of mechanical noises and consequent output distortion.

6. *Internal Disturbance.*

The application of external potential to the gas cell produces what is commonly known as "photo-cell rush." This undesirable disturbance is amplified together with the signal.

(*To be continued*)

Mechanical Recording of Sound-on-Film

A NEW method of recording sound-on-film has been announced by George K. Spoor, of Chicago, noted worker in the field of motion picture mechanics and co-inventor with P. John Berggren of the "natural vision" motion pictures which were exhibited last June at the RCA Studios in New York, being projected on a screen 30 feet high and 50 feet wide. This new recording process is the latest development of the Spoor Laboratories.

This Spoor recording process provides for making sound-on-film pictures by *mechanical* rather than by *electro-optical* means, as at present, and is based on principles which are a radical departure from the present method of recording sound-on-film. A vast improvement technically and a sharp reduction in both production and reproduction costs are claimed for the process by its sponsors.

Instead of converting sound into electrical impulses and then back into sound again by means of exciter lamp, photo-electric cells, amplifiers and other electrical devices, the new process, to be known as the "Inter-Sound System," is designed to actually carve sound grooves by purely mechanical means on the photographic film, resembling the grooves on a phonograph record.

A small pick-up on the projection machine, with a sapphire roller, fills the capacity of the phonograph needle to pick up the sound and transmit it to the loud speakers.

Novel Sound Track

The location of these sound grooves constitutes another radical departure from the present methods. While the present photographic "light-sound tracks" are placed on the surface of the film, directly alongside the perforations, these mechanical sound grooves are engraved on the edge of the film, thus leaving the surface free for the photographic images.

The new process is the culmination of a series of experiments in Chicago which were begun in March, 1929, by Mr. Spoor, P. John Berggren, and Fred Lindbergh, electrical engineer who has been active in the radio field. The finishing touches on the new apparatus were completed two weeks ago; and Mr. Spoor states that he hopes soon to be able to install his apparatus in several Chicago theatres.

New Color System Also

At the same time the inventor revealed that he is engaged in perfecting a process for taking color pictures, which he expects to be a vast improvement on the present methods. The new system, he said, would make it possible to get what is known in the industry as "critical resolution," giving sharpness to the background of the picture as well as to the foreground and the middle-ground. The present methods, he said, produced a "feathery," out-of-focus background.

Interviewed in New York by a representative of MOTION PICTURE PROJECTIONIST, Mr. Spoor made the following statement which, he said, covers the points of his new system about which inquiries are most commonly made. This statement follows:

"The first step in the new sound engraving process, is the making of a

'master record', which is carved on plain, not emulsified, celluloid, at the same time the photographic negative is being taken. From this master record, when the photographic positive prints used in the theatre are completely assembled, the sound record is engraved into the edge of the positive prints by means of an engraving machine which reproduces the master record faithfully in every respect.

"By placing a roll of clear celluloid upon a disk and passing it over a sprocket drum onto passing it over a disk, the record is carved into the edge of the film, while it passes over the drum, with a steel knife point, which is actuated by the vibrations of the microphone. This produces the master record.

Making Duplicates

"The duplicates from the master record are also made by mechanical cutting means. In this case we have two rolls of filament, one of which is the master record, passing over one drum, and the other the positive photographic print upon which the impression is to be duplicated. The latter passes over another drum, immediately alongside the master record drum, the carving tool actuated by the first filament reproducing to the edge of the second.

"When this is done the sound record for the theatre is complete with the carving into its edge. All it needs then is the pick-up device to reproduce the sound.

"In the present photographic light-track system five stages of amplification are used between the microphone and the recording machine. This causes the well-known distortion, known as 'the barrel-roll,' which always occurs with the use of amplifiers.

Less Amplification

"With the inter-sound carving system no stages of amplification are used, the reproduction of the voice coming from the microphone direct to the edge of the film. For this reason there is no loss of naturalness of the voice in the instrument.

"In addition to the improvement in tone quality our new sound films will bring about a saving estimated at $2,000,000 to $3,000,000 a year in the operating expenses of every talking picture studio. For example, there are at present about 30,000 feet of photographic soundtrack going into the cutting rooms of each studio on the Coast every day. The product costs about 10 cents a foot, or a total of $3,000. Now by the new process it becomes possible to turn 30,000 feet of film into sound with only $40 worth of celluloid.

"Again, the present light-track films require laboratory work for development. With the new sound-films the record can be heard immediately after the recording is completed without any laboratory work whatsoever.

"The 'pick-up' device, used for reproducing the sound in the theatres, is no larger than the ordinary pocket cigar lighter and costs less than $2 to make, as compared with the present price of the projection sound head."

Recalls von Madaler Process

This new Spoor process is reminiscent in some details of the system evolved some few years ago by von Madaler. The objections to this latter method (and to any method approximating it), (1) the failure to overcome film shrinkage; (2) the difficulty in transferring the sound record from the "master," or negative print, to the positive print, which was accomplished by the pantograph method, with which very poor results were had; (3) a surface used for mechanical recording should be non-resilient, which film certainly is not, but which wax is, and (4) the matter of surface tension, mechanical tension of the tracker against the film, a problem which von Madaler found impossible to solve.

When Mr. Spoor was asked if his new process "approximated" the Madaler system, he replied that it did "somewhat," but that in the main his development embodied many radically new "applications of known principles." He went on to say that the patent situation with respect to his device precluded his releasing the technical details just at present, but that he hoped to be able to supply all necessary data within a short time.

Advantages of System

The advantages of such a system of sound reproduction are, of course, obvious. The tracking stylus is similar to the electrical pick-up used for present disc reproduction and gives a greater amplification "swing," that is, a greater initial "kick" which naturally requires less amplification. It is understood that the reproduction system of Spoor requires two stages of amplification.

Economically this new Spoor system hold great promise, as both initial cost and maintenance expense would be reduced materially. The importance of this feature, however, must necessarily be of secondary interest, pending receipt of details which will indicate the relative technical merits of the new system as compared with existing apparatus.

This new development will be followed closely in this publication, with further information to be published herein as soon as it is available.

Scranton Local Union Holds Second Annual Outing

The second annual outing of Local Union 329, Scranton, Pa., was held on Sunday, August 10th, at Lake Ariel, near Scranton. More than 100 were in attendance at the outing. A baseball team representing Wilkes-Barre Local Union 325 defeated the Scranton team in the morning game by 8 to 6. Scranton attributes this morning defeat to the fact that the Wilkes-Barre boys are noted night rounders, never turning in to sleep before sunrise. The afternoon game between the same teams resulted in a victory for Scranton, 5 to 1, due, undoubtedly to the fact that they were then fully awake. Races, a tug of war, winner announced; children's races, and other sports completed the day's program.

Members of Wilkes-Barre Local Union 325 and Pittston Local Union 120 were guests of the Scranton Local at the outing. Among those present were:

Mr. and Mrs. Edward Dempsey, Mr. and Mrs. Fred Hopf, Mr. and Mrs. John De Peep, Margaret Seidler, Glen Ornstein, Robert Jeffrey, Mr. and Mrs. Blannett, Miss Hodnett, Mr. and Mrs. George A. Lerp and son, Eden; Anthony Bianco, E. A. Campagna, Edward Basko, George Menn, Mike Pane, Vincent Brazil, George R. Miles, Mr. and Mrs. Lester De Vol, William K. Brazil, T. W. Jordan, Mr. and Mrs. Gerald Lafferty, Thomas Davis, Rocco Terroto.

Also Joseph Namitka, Louise Lancaster, Joseph Dubish, John Korkobecz, Beatrice Van Trent, James Castner, Alberta Endor, Mr. and Mrs. Henry Miller, Edward Miller, T. M. Willers, Bertha Meyers, Donald Ball, George Drobnak, Lawrence Linnen, Betty Oschman, William Kelly, Mae Corcoran, Edward Pantle, Hilda Scholl, Mr. and Mrs. William Pantle and son, Phillip; Mr. and Mrs. Joseph Malloy and Junior Malloy, Nancy Malloy, Leon Malloy, Mr. and Mrs. John B. Mitchell, Masters Jimmie and Jackie Mitchell, Dorothy Richmond, William Wolfe, Joseph M. Ohall, Dominick Bambico, Charles Beuorvcht, Mike Kubec, Vincent Constanzi, Charles Terroto, Louis Cimino, Clayton Lease, Roosevelt Decker, J. L. Pyle, and Joseph McHugh.

Members of the committee on arrangements for the affair were Lester De Vol, chairman; Edward Dempsey, John De Peep, John Korkobecz, William Brazil, and George Miles.

Care of the Fader

If you will clean your fader well with carbon tetrachloride, then use the ink end of an Eberhard Faber No. 110 eraser followed by just a *trace* of vaseline your troubles will be over. Clean all the rings that have worn on the contacts, then with one finger smear a very little vaseline on the palm of one hand, then with a dry finger take up some of this vaseline and wipe it on the fader contacts.

After you have wiped your hands clean take a dry finger and wipe the contacts nearly free of vaseline. Don't leave enough to see as only a slight suggestion of vaseline is necessary. If these instructions are followed only about one-third the cleanings will be necessary as when the contacts are left dry. This method is also very good for any place where moving contacts are used in the system.—A. P. S. *Loudspeaker.*

Fundamentals of Auditorium Acoustics

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II*

WHENEVER there is a time lag greater than one twentieth of a second between two successive and similar sounds, echo becomes perceptible and annoying, particularly when the echo comes from a curved surface which concentrates the sound at the listening point. Translating this time interval in terms of the path difference between the two sounds—that is, the difference between the total lengths of their paths in traveling from source to listening point—the path difference should not be greater than 56 feet. Fig. 9 shows how this condition may exist. The path of the reflected ray is 38+43, or 81 feet, which is 56 feet longer than the direct path.

An echo may sometimes consist of several distinct rapid repetitions of the original sound, in which case it is called a "multiple" or "flutter" echo. In this case the sound reflects back and forth between the smooth parallel walls. An echo usually can be distinguished very easily by making a sharp report in the room such as a "hand-clap." When hands are clapped between parallel walls sometimes a dozen or more successive reflections (flutter echo) can be distinguished. Special sound ray apparatus using a sharper beam of sound is sometimes found necessary in locating troublesome echoes.

Common Source of Echo

Echo is most generally encountered in large rooms, particularly those with barrel vaulting domes and other smooth curved surfaces. Architectural design often calls for curved surfaces with radii of curvature equal to the major dimensions of the auditorium: for example, the radius of curvature for a curved rear wall is usually equal to the length of the room. (Fig. 10.) The effect of such a surface is to throw the sound back to the source at S1 and create serious echo. Besides, such a surface, since it concentrates the sound so greatly, gives rise to non-uniform loudness of sound, forming loud and dead spots.

In general, flat surfaces are to be preferred to curved ones, but curved surfaces of a radius of twice, or greater than twice, the major dimensions of a theatre will not usually give serious trouble. (Fig. 11.)

Effect of Irregular Surfaces

The echo effect of a surface may be reduced by changing its shape, by treating it with a sound absorbing material, or both. Breaking up smooth surfaces with irregularities, such as coffering, pilasters, doorways, box tiers, etc., minimizes echo by dispersing or scattering the sound wave in several different directions. The treatment for echo is particularly important when using directional loudspeakers since such speakers direct the sound in a concentrated beam, and oftentimes good volume distribution is sacrificed because the speaker cannot be set to cover all the audience without directing some of the sound toward the echo-producing wall.

Like reverberation, echo causes blurred speech and music.

Resonance

The phenomenon of resonance, or the ability to vibrate best at certain frequencies, may occur in structures or in the air in rooms. Structural resonance usually is not harmful unless the resonant body is mechanically connected to the source of sound; for example, many musical string instruments have the vibration of their strings reinforced by a resonant body of wood which is mechanically connected to the strings.

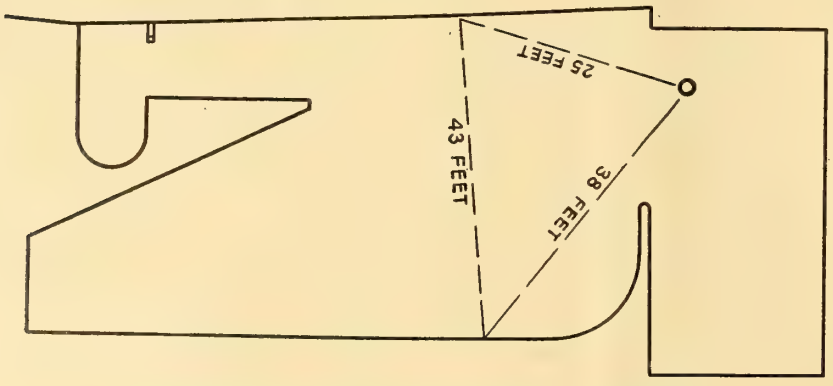


Fig. 9—Illustrating production of echo in an auditorium

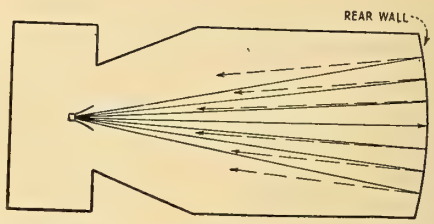


Fig. 10—Concentration of reflected sound by curved rear wall of auditorium

Resonance in air chambers, such as the rear orchestra section under balcony, alcoves, foyers, etc., does not occur very often unless such chambers are bare of furnishings and have hard reflecting surfaces.

Absorption of Sound

The blurring and distortion effect on speech and music caused by reverberation, echo and resonance has already been pointed out. Of these defects, excessive reverberation is the most common in auditoriums. We now come upon methods for curing these defects.

Echo and resonance can oftentimes be overcome by changing the shape of the surfaces producing them. Likewise, reverberation can sometimes be minimized by reducing the size of the room. Changing the shape and size of theatres, however, is not often feasible, particularly after the building has been constructed. Thus, the most common method of cure is to increase the absorption of the ceiling, walls, floor, seats, etc.

The amount of sound which a material will absorb depends on its porosity and on its ability to vibrate as a whole. In general, materials absorb mostly due to their porous nature. Thus plaster, cement, brick, marble, and wood surfaces, etc., absorb less than 5% of the sound energy which strikes them, while felt-like materials, plush drapes, carpets, heavy upholstered seats, people's clothing, and all the special sound absorbents made out of mineral rock wool, cane fibres, wood fibres, corn shreds, seaweed, asbestos, etc., absorb more than 25%, and a few absorb more than 70%.

In general very few auditoriums contain a sufficient amount of sound absorbing material unless they have been specially treated. The efficiency of a sound absorbing material depends not only on the nature of its composition but also on its thickness, and the way it is installed. Usually a material increases in absorption efficiency, particularly at the lower frequencies, with an increase of thickness and with an increase of air space between the wall and the material. In sound motion picture houses, the most effective placement of absorbing material is usually on the rear

* No. I appeared in August issue.

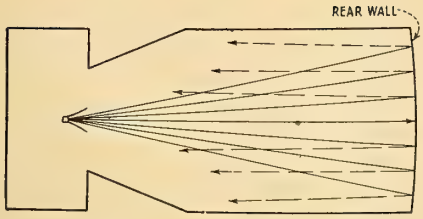


Fig. 11—Curvature of wall lessened to avoid concentration of reflected sound

and side walls, and the front section of ceiling above the proscenium.

Projection Room Acoustics

Since the reverberation time depends on the absorption in the room, the reverberation varies considerably with the audience unless the seats are heavily upholstered. The use of heavily upholstered seats is very desirable since it keeps the reverberation and consequently the sound loudness constant, irrespective of the audience present.

The absorption treatment of the walls and ceiling inside the projection room, which has heretofore been neglected, is very desirable. Such treatment would result in the following: (a) reduction of noise in the room; (b) reduction of noise transmitted to the auditorium; (c) increased working efficiency in the projection room; and (d) possibility of the complete control of the volume by the projectionist because of the improved hearing conditions in the room.

Transmission of Sound

A theatre with good acoustics has its walls insulated against the transmission of outside noises into the auditorium. The transmission of sound is of two kinds—aerial and structural. Small openings due to doors, windows, port holes, etc., transmit sound to a great degree. Thus, all the joints between walls, doors, windows, etc., should be made as air-tight as possible.

Transmission of sound through structures, such as the noise from vibrating motors and machinery, can be minimized by using massive walls and floors, and by separating all vibrating bodies from their supporting structures with sound insulating materials such as cork, felt, lead, and rubber, used singly or in combination.

Relation of Volume Control Setting to Reverberation Effects

Massive walls are not always necessary to obtain sufficient sound insulation. A double wall of fairly light construction will give good sound insulation provided the two walls are not closely coupled mechanically by nails or cross members; that is, provided the walls are kept isolated or separated from each other as much as practicable.

It was stated previously that the sound energy within a closed room is reflected back and forth between the walls until entirely dissipated. The length of time required to dissipate the sound energy produced by a loud speaker depends upon the amount of sound energy produced, the size of the room, and the amount of sound absorbing material in the room.

If there is very little sound absorbing material in the room, a small amount of sound energy will produce a high volume of sound. If the sound energy is quickly absorbed, a large amount of sound energy is required to give the desired volume level. If the same volume control setting were used for a nearly empty house as is used for a full house, the volume level would probably be too great, and an undesirable amount of reverberation would be experienced.

Therefore, it is a good plan, when operating to a partially filled house, to reduce the volume control setting to give just enough volume so that the sound will be intelligible at the last row of seats used by the audience. This is particularly important when the house is excessively reverberant and where un-upholstered seats are used.

New Motiograph Cylindrical Shutter Adaptable to All Models

TWO years ago the Enterprise Optical Mfg. Co. announced its Model "H" projector, the first projector to appear with the horizontal cylindrical rear shutter. The success of this mechanism in improving projection, eliminating heat from the film and reducing heat at the aperture has been proven during the time it has been on the market.

Advantages of New Shutter

Users of the former Model "F" projector which had the front type of shutter have been demanding equipment to convert their mechanisms for the use of the horizontal cylindrical rear shutter. This is now available. The equipment furnished to adapt the Model "F" mechanism includes the complete horizontal shutter, housing and driving elements identical in construction and operation to the shutter as supplied on the Model "H" mechanism.

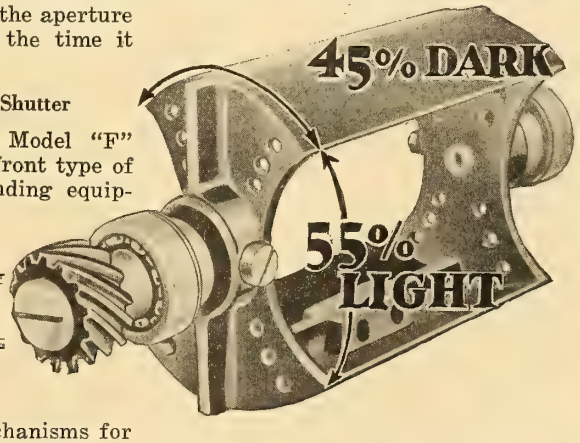


Figure 1

The advantages of the horizontal cylindrical shutter are many, especially in view of the particular requirements for sound projection.

The need for increased illumination, made necessary by the use of so-called "porous screens" in sound projection is fully met with in the horizontal cylindrical shutter, in addition to its function to reduce the heat on the film. Also, by reason of its design, this shutter permits a greater percentage of light to reach the screen over that of the old-type front shutter. This is evident from a comparison of the two types of shutters as regards blade area.

In the old-type shutter the pro-

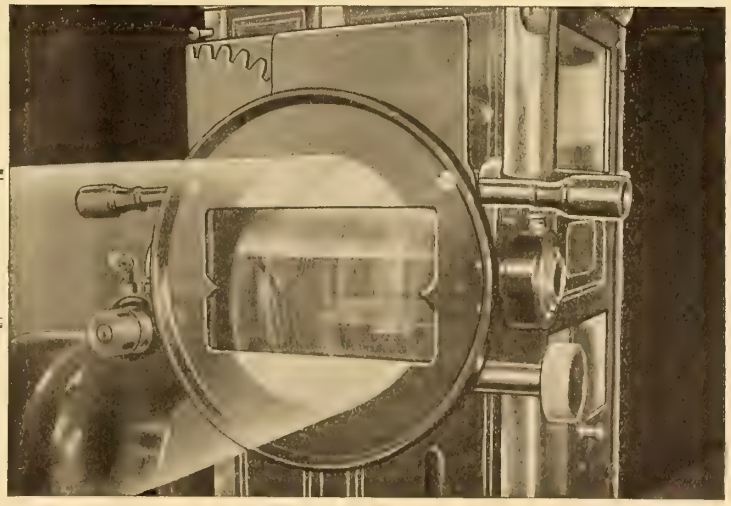


Figure 2

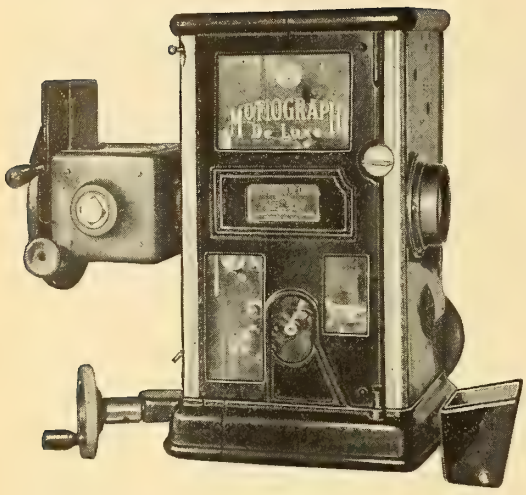


Figure 3

portion of blade area as against light opening was in the nature of 60 per cent blade area and 40 per cent light opening. The horizontal shutter has a blade area of only 45 per cent with a light opening of 55 per cent as illustrated in Figure 1.

This, as may be figured, represents a direct increase of 15 per cent over the old type shutter. An additional increase must be considered due to the efficient cut-off principle involved in only the horizontal cylindrical type of shutter. By reason of its cylindrical shape, the shutter cuts off the light beam from top and bottom simultaneously, resulting in a quicker cut-off than is possible with a disc type shutter and obviously resulting in a greater gain in illumination. This action is clearly illustrated in Figure 2.

Here, the two blades of the shutter are shown in action in the light beam. One may be seen near the aperture cutting the light beam from the bottom, while at the same time the top blade may be seen cutting the light beam from the top. The shutter when attached to the Model "F" mechanism has the appearance as shown in Figure 3.

Effective Cooling Device

It affords the Model "F" user all the advantages insofar as the shutter is concerned, as are obtainable with the later Model "H" mechanism. These include the increase in illumination, the same advantages of reducing the heat on the film, heat at the aperture, light dowser on the shutter housing, shutter setting and adjusting device, etc.

The horizontal cylindrical shutter also offers the advantage of forced air circulation which efficiently cools the mechanism film gate, film tension device and aperture to a degree only slightly greater than room temperature. In addition these forced air currents perform an important function in preventing free dust and dirt from reaching the film. This is of especial value in sound film projection. The action of these air currents is shown in Figure 3.

The horizontal cylindrical shutter for attaching to the Model "F" mechanism is not an attachment or makeshift in any sense; but is identically the same as on the Model "H" mechanism and includes the shutter and housing drive shafts and attaching parts.

Arrangements have been made at the factory, and it is suggested, that the installation of the horizontal cylindrical shutter be made at the time the mechanisms are sent in for repair. In this way the mechanism may be put in perfect running condition and when so handled, the new shutter is installed at no additional charge for labor. The installation does not require structural changes in the mechanism in any way, nor does it involve special drilling or fitting.

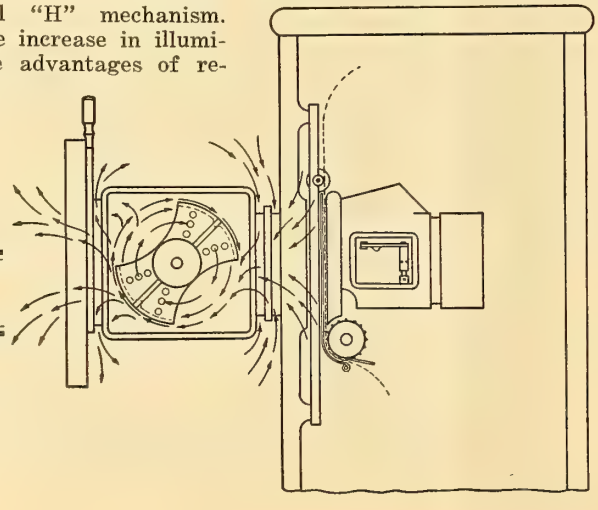


Figure 4

Unusual Sound Installation at Naval Academy

One of the most unusual jobs ever put up to the Electrical Research Products engineers is the recently completed installation of a Western Electric Sound System in the Auditorium of the U. S. Naval Academy at Annapolis, Md. Features of the auditorium and academy regulations combined to demand special precautions in completing the job.

An entirely new projection room had to be built and horn boxes constructed that were light, portable and sturdy. In building the room steel plates were used for the floor on top of a lining of one-half inch sheet asbestos. The walls of the room, of one-eighth inch galvanized iron sheets riveted throughout, were built on an angle iron framework.

The battery room, adjacent to the main projection room, was similarly constructed. A ventilating system was installed to exhaust the lamp and battery room gases to the outside air.

Horn Arrangement

The sound system conduit was run above the room and the entire set of conduit runs was covered with another steel "deck" to be used as a spotlight platform for any amateur shows produced by the midshipmen. This upper deck is removable in sections over the conduit fittings to make the wiring runs easily accessible.

The front and outside walls of the room were treated with Celotex and draped with a heavy velour curtain to harmonize with the auditorium appointments.

The horns were supported so that they can be removed at times when the entire stage is needed for the midshipmen's shows. To make the horn boxes portable rectangular frameworks of three-quarter inch pipe were cross braced on five sides with aeroplane cable and turn-buckles. The cable was wound and taped to prevent vibration. The entire box, with the exception of the front, was covered with Celotex and bolted to a polished copper framework. Suspended at a definite height they were made level by a series of stout manila ropes. When the time comes to remove them temporarily from the stage this can be done by "dollies" with rubber tired wheels that can be brought under each one.

Many Applications of Carbon

Carbon is a material of peculiar characteristics adapted to many uses for which no other material is available nor so well suited. The following list of some of the industrial applications of this material will undoubtedly prove a surprise to many who held the idea that this substance had comparatively few applications in the communications field:

Four Main Fields of Use

Illumination: Projector carbons, photographic carbons, photo-engraving carbons, blue printing carbons, searchlight carbons, sunshine and therapeutic carbons.

Manufacturing: Welding carbons, carbon electrodes, chemical applications.

Telephone: Back plates, diaphragms, granular carbon, globular carbon.

Special Applications: Switch and circuit breaker contacts, turbine packing rings, automobile clutch thrust rings, resistance discs, lightning arrester carbons.

Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

PRACTICAL methods of correcting troubles that require plenty of experience to learn, can usually be told in a very few words. The projectionist who makes use of not only his own methods of procedure, but the accumulated practical experience of others, can accomplish more in less time. Troubles that occur to one projectionist may not happen to another; however, always be alert for anything to happen to sound reproducing equipment.

It is quite evident that a certain amount of vertical needle pressure is necessary to provide proper tracking with records; as a consequence, records must be made of hard material and they must be abrasive enough to stand this pressure. Never use soft tone needles because they have a very poor frequency response, and the characteristics indicate that the higher frequencies are eliminated.

Disc Reproduction

Our experience relates that the most pronounced deformation of any needle occurs during the initial period of service. It is quite true that very few producers are using disc recording—however, for those who are recording on disc, we must endeavor to make the reproduction as good as possible. Distortion, which usually occurs during disc recording can many times be traced to the pick-up. A good stiff needle is required for faithful reproduction — otherwise, movements at the armature end of the needle will not represent movements at the groove end on the record.

We desire to have the natural frequency of the system somewhat above the highest frequency to be reproduced. Many projectionists are using half-tone needles and many projectionists are still using the full-tone needles, and many have never given the subject much thought.

A magnetic pick-up requires damping in order to smooth our resonant points, and at the same time maintain the proper neutral position of the armature. The Western Electric 4-A reproducers have these qualities. Half-tone needles play a very important part and may be considered as a mechanical filter in disc reproduction.

W. E. 4-A Reproducer

The Western Electric 4-A reproducer consists of a stylus connected to an armature of high permeability, which is located within a small coil. In operation the stylus attached to the armature vibrates as a needle follows the grooves on the record. The movement of the armature between the poles of the magnet which surrounds the armature causes a variation in magnetic lines of flux and a voltage with corresponding variations is induced in the coil.

If too much stiffness exists in the stylus, the relative motion of the armature and field will be reduced. The stylus should never be struck or twisted in an effort to remove a needle that is jammed. Do not allow dust and dirt to accumulate around the stylus.

Free movement of the armature within the unit is necessary. Distortion will result, if this part cannot move freely; on the other hand, if the armature moves too freely a sputtering will result. I have found, on a few occasions, that complaints about sputtering and "frying" sounds in disc recording were caused by a loose needle.

Clean Records Essential

Always dust the record thoroughly before using. I have found that many projectionists have neglected to do this, with the result that the full amplitude of the recording was greatly reduced, because dust and dirt interferes greatly with the full motion of the stylus. Be positively sure that the tone arm is well balanced with uniform pressure, not too light and not too heavy. Uneven pressure of the tone arm will cause a flutter in disc recording.

Needles should only be used once and then discarded—in other words, they should be replaced at the same time when the record is changed. Worn needles will result in loss of high frequencies, because they cannot follow the high frequency grooves.

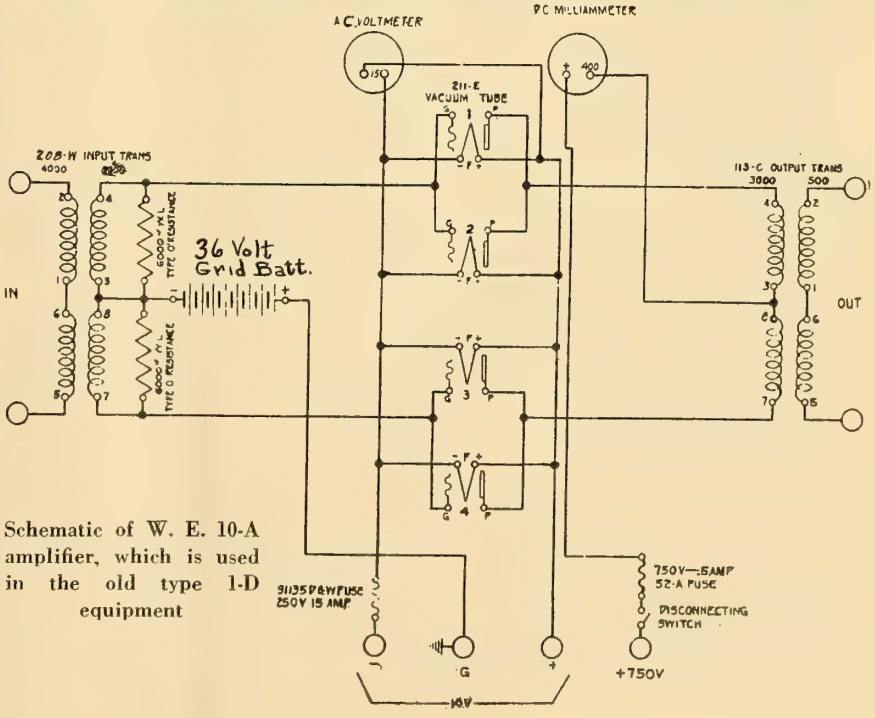
We are compelled to replace needles frequently in order that the needle point diameter may be small enough to follow the high-frequency modulations. There are many types of magnetic pick-ups; however, the same theory in operation applies to all.

Ionization in Tubes

If plate voltages, considerably above normal values, are applied to some vacuum tubes it becomes possible to see a blue glow or haze inside the tube in addition to the usual light from the filament. This means that ionization is taking place inside the tube and that slight amounts of gas have been made partial conductors for electric current.

The breaking down of a gas by ionization means the separation of negative electrons from positive ions. In this condition it is possible for electric currents to flow through the gas independently of the true electron emission effect between the hot filament and the charged plate. There is then a conducting medium in place of a practically perfect insulator inside the tube.

In a vacuum tube, having an imperfect vacuum, ionization may be



Schematic of W. E. 10-A amplifier, which is used in the old type 1-D equipment

started by using too high filament temperatures. With normally high vacuum, ionization is seldom caused by excessive filament temperature, but is caused by using very high plate voltages—much higher than the tube is designed to use. High plate voltages cause heating of the metal in the plate above its normal operating point. The hot plate may emit some gases from itself, and atoms of these gases are broken up in ionization. If gaseous amplifier tubes are used, peak distortion, harsh and rasping tones will result.

Vacuum Tubes

All substances are made of electrons. When most metals are heated some of the electrons in their make-up "boil" off. The purpose of the filament in vacuum tubes is to give off electrons. Electrons are negative particles of electricity. If a vacuum tube was full of some fluid like air, electrons given off would fall back into the filament. When there is a vacuum around the filament, the heated parts are protected from oxidation and the electrons easily boil out and fill this tube.

The grid is next to the filament and if it is well insulated so that the electrons cannot leak away, it will collect electrons until it is negatively charged. Out beyond the grid is the plate. If we connect a battery between the filament and the plate with the positive terminal next to the plate, the positive plate will attract the negative electrons. As fast as the electrons come off the filament, they fly over to the plate.

Control of Current

Electrons in motion make an electric current. The amount of current depends on the size and temperature of the filament, the voltage of the battery and the resistance in the different parts of the circuit. The potential of the grid has a marked influence on the current too. An ammeter or milliammeter anywhere in the circuit will measure the current that flows.

When current flows through a resistance, we have what is called "voltage drop" across the resistance. The voltage drop is always equal to the voltage which causes the current to flow through the resistance. The voltage drop across the filament of a vacuum tube can always be found by "ohm" law and is the "resistance" (of the filament), times the current flowing through it.

Noisy Operation

A complaint was received recently stating that considerable noise was encountered during the showing of Movietone subjects on one projector when the fader was run a few points above the normal setting. An investigation indicated that the photoelectric cell amplifier was not swinging freely and that vibrations which emanated in the projector were being carried through the reproducing system.

A frequent cause of hum in the sound reproducing system is a rectifier tube in which the emission on one side will be considerably less than the other. Poor tone quality may often be caused by a defective tube, this being more noticeable when the volume is increased.

Either low filament or low plate voltage will cause mushy reproduction.

Exciting Lamp Life

We have received many complaints regarding the life of exciting lamps. The rated current value for each exciting lamp is 4 amperes, 8 volts. The normal operating value of these lamps is 3.9 amperes. It is quite evident that by reducing the value under 3.9 amperes the filament will not deteriorate so rapidly—however, when you reduce this value, the volume and brilliance of the reproduction will be greatly impaired.

ERPI exciting lamps have given greater length of service than other lamps of equal manufacture. Exciting lamps should last 100 burning hours or more. Be positively sure that the current value is correct and that the meter in this circuit is indicating the rated values.

Trouble "Shooting"

Scientific and systematic methods of locating and remedying faults in sound equipment amplifiers have been developed to such a fine point that they now exceed in precision, speed and efficiency, when trouble occurs. We started with equipment which required storage batteries for power supply. Sound equipment has been somewhat simplified with the installation of motor generator sets and rectifiers, thus eliminating all storage batteries.

We have mentioned before the value of routine testing and inspection. There are many troubles in amplifiers that do not show up under no-load conditions, but do show up plainly under the normal load. Intermittent open circuits and high-resistance joints, sometimes fall into this class. It is becoming increasingly common to find that most troubles emanate from defective vacuum tubes. Western Electric sound reproducing equipment is very substantial—however, it will not stand neglect and abuse.

Appreciation is due and is in full measure given to the many projectionists throughout the world, who have studied the fundamentals of power amplification, which assisted greatly in the success of sound pictures.

One of the greatest expenses in maintaining sound reproducing equipment is the replacing of vacuum tubes. All vacuum tubes which are termed defective, do not fail prematurely as is believed by many projectionists. Regardless of the age of vacuum tubes, they should be handled with extreme care. The filaments of power amplifier tubes should be heated fully five minutes, before turning on the plate supply, in the Western Electric power amplifiers.

Microphonic Tubes

I was asked recently to explain what caused a vacuum tube to become microphonic. Many projectionists have had experience with a microphonic tube in the photoelectric cell amplifier, which would result in a whistling noise, which would become louder and louder until the amplifier was shut off or the fader brought to zero. A "microphonic tube" is simply an ordinary tube in which one or more of the elements are loosely mounted when assembled. It is essential that all the tube elements (grid, plate and filament), should be mounted and supported so that a rigid, fixed relation is maintained between them.

If any of the elements vibrate, the spacing between them changes and thus the normal characteristics of the tube are changed. For example, a tube having a low voltage amplification factor is constructed with the grid and plate elements mounted close together; whereas in a tube having high voltage amplification the grid is placed comparatively close to the filament and at some distance from the plate.

Cause of Howling

If sound vibrations cause a tube to move, then any loose elements within will also move. Any change in the distance between these elements will cause the value of the plate current to be affected in proportion. The plate current variations are then magnified by the amplifying stages following the "microphonic tube" and are reproduced as a swinging howl, varying in pitch according to the vibration period of the tube elements. In some cases interchanging the tubes will correct this condition.

The first stage of the photoelectric cell amplifier, which employs 239-A W. E. amplifier tubes, usually is where this trouble occurs. Microphonic tubes, which cannot be used in the photoelectric cell amplifier, should not be discarded. They can be used in the 41-A amplifier, because there is less vibration in this amplifier.

Unusual Troubles

Many things happen with sound reproducing equipments, which seem to be impossible when fully explained. Before the opening of a theatre, with sound equipment, it was found that one of the photoelectric cell amplifiers developed a microphonic noise. Tubes were changed and even the amplifier itself was changed and

everything was thoroughly checked, but the microphonic noise was still there. The master fader cover was finally removed.

The two-conductor lead cable from the output of this projector was found to be defective and upon further investigation we found that the lead cable throughout the entire installation was in the same condition. The lead cable was broken in several places, especially where it was pulled around a bend and in many places the insulation was broken, leaving the wire slightly touching the conduit. The p. e. c. batteries were immediately removed from the battery room and placed near the projector and connected to the 90-volt terminals.

Another pair of leads were run from the photoelectric cell amplifier output to the input of the fader, with the result that the microphonic noise disappeared. After the defective lead cable was replaced this trouble was never encountered again.

Film vs. Disc

All studios producing feature pictures, with the exception of Warner Bros., are recording sound-on-film. It has been emphasized that Warner Bros. will, in the near future, do all their recording sound-on-film instead of sound-on-disc. One of the greatest assets of sound-on-film is the elimination of the problem of synchronism, also the nuisance of shipping separate records with the film print.

I personally favor the sound-on-film. In those projection rooms where only sound-on-film is being shown, the disc turn-table shaft should be disconnected from the motor shaft, which would eliminate that much extra pull on the projection motor.

Museum Solicits Aid in Technical Collection

THE following communication apropos of the development of the motion picture section of the great Museum of Science and Industry, the Chicago instiution founded by Julius Rosenwald, is worthy of the consideration of everyone in the motion picture industry. Insofar as the technical phase of the business is concerned, no one is better in a position to be of assistance to the Museum in their worthy endeavors than projectionists of long standing who are familiar with the early apparatus and know of the whereabouts of many of these relics. The Museum will be more than glad to credit the contribution of any donor.—The Editor.

EDITOR, MOTION PICTURE PROJECTIONIST,

Sir: The Museum of Science and Industry in the city of Chicago is the result of an endowment of $3,000,000 by Mr. Julius Rosenwald, for the equipment and maintenance of the institution, and a $5,000,000 bond issue voted by the people of the city to the South Park Commissioners, for the reconstruction of the old Fine Arts Building in Jackson Park which will permanently house the technical collections of the Museum.

In this Museum the history of science, engineering and industry will be interpreted, not only by three dimensional working models, but (and this is something that has not been attempted anywhere) also so presented that the social and economic causes and results, the little known background of all the epoch-making inventions and discoveries, will be clarified.

A considerable amount of space will be given over to tracing the evolution of the motion picture from its primitive beginning to the present day. This is a subject which has not been treated adequately in any museum in America. In order to trace this development effectively we must show, in addition to modern motion picture equipment, historical relics which in their day played an important part in the building up of the motion picture industry. No doubt many of these relics are still collecting dust in storerooms and may eventually find their way to the junk heap. We should like to appeal to your readers who may know of the location of some invaluable piece of apparatus which might well find a home in the first technical museum in America. Much of this apparatus is no longer of use to the motion picture industry, but in the education of the public in a museum such as this it would play an important role.

Will you not have the kindness to publish this request in a coming issue of your magazine and inform your readers that if they know of the whereabouts of such material it will be greatly appreciated if they will communicate their knowledge to the undersigned.

Faithfully yours,
John A. Maloney,
Assistant to the Director, Museum of Science and Industry, 300 *West Adams Street, Chicago, Illinois.*

Contract Negotiations

(I. A. Bulletin No. 253)

The International Alliance is faced with the most serious and complicated contract negotiating period in the history of the organization, and it is to be hoped that the wage-scale committees in the hundreds of localities, engaged in the important work of negotiating new contracts with the employer, will draw fully upon their experience and knowledge of the work in hand in attempting to work out a satisfactory and equitable agreement. Every effort should be made to avoid a strike. Negotiations should be carried on for the purpose of arriving at a settlement rather than a strike.

We are told: "The wise man must be wise before, not after, the event." To the vast majority of local unions this admonition will be unnecessary, as experience has taught the seasoned leadership of the great majority of the local unions of the Alliance that reasonable progress by far excels a magnificent promise of impossibilities.

General Office Aid

The entire resources of the General Office are at the complete and free disposal of each of the six hundred and ninety local unions comprising our International Alliance. The General Office will gladly co-operate with every local in an earnest endeavor to arrive at a satisfactory agreement in every locality.

The local wage-scale committees engaged in the important task of negotiating new agreements are specially asked to continue such negotiations just as long as there is any hope of reaching an amicable settlement. Strikes should never be resorted to as long as there is any avenue of conciliation available. This policy is in complete conformity with the declaration of International Conventions, and it is hoped that prudent judgment will be exercised throughout the International Alliance in endeavoring to come to satisfactory terms with the employer.

Australian Plan Provides for Film Damage Penalty

The following excerpt from an Australian motion picture trade journal is interesting in connection with the campaign being waged in this country to lessen film damage:

Owing to the amount of damage being caused to sound film, the Film Exchanges' Association is instituting a system of projectionists' reports. A pad of forms will be forwarded to each theatre and the projectionist will be required to send in to the exchange concerned a report on the condition of film received.

Standard Report Forms

Any theatre not sending a report will be held responsible for any damage found in the film before the next screening. On the back of each report form will be a diagram of a correct join, a list of appliances for film repair which every projectionist should have, the various types of damage to film, the various causes of this damage, and what to do to rectify the causes.

It is considered essential in the interests of the business generally that sound film be treated with care, and it is believed that this system of projectionists' reports will enable the cause of damage to be quickly located.

Recording Sound on Disc

By NUGENT H. SLAUGHTER*

THE important features of any method of recording are quality of reproduction, uniform and reliable performance, and adaptability to a rapidly changing art. In all these respects disc recording compares well with other methods.

The recording of sound on disc involves processes entirely common to other systems of recording, except for the actual conversion of electrical energy into some form of permanent record and the steps immediately following up to the point where the record is employed to re-establish electrical energy. Since those processes common to other systems of recording have already been described in some detail, this discussion will be confined to the processes peculiar to wax recording and their analogy to certain processes in film recording.

Materials Used

The material used in the actual making of a disc record may be called the wax negative stock corresponding to the negative film employed in the film recording process. The wax negative consists of a soft wax blank in the form of a very thick disc which has a consistency and appearance much like beeswax. Its surface must first be prepared, not by sensitizing, as in the case of film, but by a smoothing process known as wax shaving, which makes the wax negative receptive to mechanical, rather than light, impressions.

The shaving of wax is accomplished on machines. This entire machine must be set up with great precision so that it will be free from vibration and so that the carriage which supports the knife and moves it across the wax will perform in a very uniform manner. Most important of all is the cutting knife itself which is ground from selected sapphire, the only material which has proven satisfactory for this exacting service. The grinding is done with the finest of diamond dust and is carried out with the greatest of skill and care to obtain a cutting edge more than a half-inch long which will be so perfect that it will leave the wax with a mirror-like finish.

Occasionally one of these spinning waxes will break because of some internal defect, and fly off the turntable of the wax shaving machine with serious results for the operator. For this reason the hinged guard has been provided.

In spite of the great precision required in wax shaving, the cost of wax "negative stock" is very much less than the corresponding cost of film negative stocks, the saving amounting to many thousands of dollars annually for a studio of moderate size.

In the recording of a disc record one of these wax negatives is placed on the turntable of a disc recording machine. This turntable is driven through a system of gears enclosed in the large gear pot shown directly beneath the turntable by means of a motor which is at all times synchronous with the motor used on the stage to drive the camera so that the proper relative speeds of the wax and film required for synchronism will be maintained.

The record speed is 33⅓ r.p.m. which corresponds to 90 feet per minute traveled by the film in the photography or projection of sound pictures. The large gear pot contains an oil damping arrangement designed to eliminate any small speed variations of the turntable which might otherwise be introduced by the motor and gears so that the speech or music recorded will be entirely free from flutter.

Electrical Recorder

An electrical recorder rests lightly on the surface of the soft wax, and by means of a sapphire cutting jewel or stylus cuts a shallow groove in the wax as it rotates. The depth of this groove is controlled by a sapphire advance ball which may be adjusted by the thumb screw at the right of the recorder. As the record rotates the recorder as a whole is slowly drawn from the inner part of the record toward the outer edge so that the groove has the familiar spiral form.

The rate of advance of this spiral may be set at any one of three different speeds by means of gears. The speed chosen will depend upon the character, particularly the loudness of the sound being recorded. At the beginning of each record a much wider-spaced spiral is used to separate the start of the first groove from the body of the recording so that the operator in the theatre will have no difficulty in setting the needle of the reproducer exactly on the starting point. This special spiral groove, which lasts for about one turn of the record, is accomplished by a cam which engages for this first turn only.

As the record proceeds the speech or music sounds on the stage set up an electric current in the system which is essentially an electrical copy of the sound, and this current is applied to the electrical recorder, causing the stylus to move from side to side.

The means of accomplishing this side to side motion is as follows:—A strong magnetic field is set up across the pole pieces by means of the magnetic field coil. The diamond shaped armature to which is rigidly connected the cutting stylus stands in this magnetic field between the pole pieces, and around it are placed the two speech coils through which are passed the amplified electric currents from the stage. These currents cause either end of the armature to be poled alternately north and south magnetically in accordance with the speech current, and the resulting magnetic forces cause the armature to rotate or oscillate about its axis, thus moving the stylus from side to side.

Playbacks

At the conclusion of a scene or take we have in the wavy grooves, something which corresponds to the latent image on a piece of film which has been exposed in the film recording machine. There is, however, one important difference in the fact that the wax record may be immediately used, if we so desire, to reproduce the sounds which were recorded on it. This procedure, known as making a playback, usually results in sufficient damage to the wax so that it would be unsuited for use as a final reproduction. For this reason an extra wax is usually recorded where a playback is required.

These playbacks from soft wax records are frequently of great value, not primarily as a check on the recording but rather as a check on the performance which has been recorded. Many directors rely to a large extent on playbacks, while others take little interest in them. Although their true value in aiding production cannot be accurately estimated at present, playbacks will certainly find a place of much importance in the ultimate scheme.

Having completed the recording of a scene which the director has approved after hearing one wax played back, the other wax record or records go through additional processes which correspond generally with the film development and printing. After suitable preparation, the wax record is immersed in an electroplating bath by means of which a heavy layer of copper is deposited on the surface of the soft wax. This copper layer or shell, when separated from the wax, constitutes an exact copy of the original recording, except that it is negative in character, bearing ridges

(*Continued on page* 32)

* Technical Digest, Academy of Motion Picture Arts & Sciences.

New Equipment and Appliances

New Condenser System for Wide Film Projection

THE huge size of modern play houses creates many a problem, one of the most important being the difficulty of obtaining even illumination of the screen by a brilliant light free from chromatic aberration and from ghosts. Extensive research work has been undertaken by lamp manufacturers and optical firms here and in Europe to attain this goal.

Until last year the best condenser system available consisted of a pair of plano-convex lenses of different diameters and focal lengths. The most light thereby obtained on the screen with the use of one of the best high intensity arc lamps amounted to about 5,500 lumens.

A parallel beam of light overcomes distance more efficiently. This thought caused the use of parabolic condensers. Since the film-window is rectangular, the projection of a round spot means a waste of light. An oval spot covering all four corners of the rectangular window was finally developed by means of grinding a cylindrical curve on one side of a condenser, thereby broadening the beam of light in one direction. Steps were also taken to increase the amount of light emanating from the arc—in other words, the collecting angle was enlarged.

This resulted in a special condenser system for wide film projection made by Fish-Schurman Corp. of New York and consisting of:—

one—5½ diameter Grand Special A cylindrical, spherical, biconvex, and

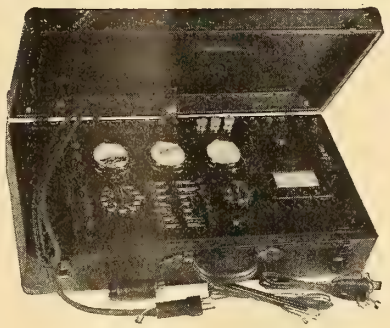
one—6" diameter Grand Special B parabolic convex-concave.

If made of genuine optical glass the amount of light on the screen increases to about 10,000 to 15,000 lumens for this Fish-Schurman system, as compared with the 5,500 for the old system.

Since the Grand Special A condenser rests very close to the arc, it must be made of special heat-resisting glass like Ignal glass, which defies the heat and which represents the best type of genuine optical glass. It is necessary for such an optical system to use a glass of such high purity that it will not discolor in spite of the terrific heat of the arc to which it is exposed. Additional information can be obtained by communicating with Fish-Schurman Corp., 45 West 45th St., New York.

Jewell Analyzer for Sound Picture Equipments

THE Jewell Electrical Instrument Company, Chicago, has recently developed a compact analyzer for



New Jewell analyzer

checking sound picture installations. The analyzer consists of four instruments mounted in a case built to stand the severe usage of service work.

The analyzer has a direct current meter with ranges of 15-150-750 volts, 7.5-75 amperes, 1.5-15-150 milliamperes; an A. C. meter with 4-8-125-250 volt ranges; a thermocouple galvanometer with scale reading 0 to 100, 4½ ohms resistance, 115 milliamperes full scale; and a Jewell Pattern 149 galvanometer reading 15-150 microamperes.

Gives All Readings

This analyzer gives all filament, control grid, screen grid, and plate readings. Means for making complete tube tests, using the change in grid bias method and means for output measurements of both volume and quality, using variable pitch constant frequency records or films are provided. A feature of this analyzer is that it provides means for measuring photo-electric cell current on a microammeter with ranges of 15 and 150 microamperes.

The analyzer also provides means for measuring continuity and resistance and phasing dynamic speakers. A complete set of binding posts make all meter ranges available for testing independent of the analyzer. The use of a four-pole, twelve-position switch for pre-selecting the circuit and push buttons for operating the circuit makes operation of the analyzer simple, rapid and safe.

The analyzer is furnished complete with adapters and test leads, place for which is provided in the case.

Forest Electric Has New Line of Rectifiers

A NEW and improved line of rectifiers has been announced by the Forest Electric Corp. of Newark, N. J., and are now being distributed in the trade. Forest has had many years experience in the rectifier line, and these latest developments of the Forest laboratories are the last word in rectifier efficiency.

The principle of operation of a rectifier is as follows:

Principle of Operation

Alternating current enters the fuses from the supply line and passes to a quick break heavy duty enclosed switch which cuts "on" and "off" the entire supply to the rectifier. From the switch the alternating current is fed to a double wound heavy duty transformer the primary of which is provided with an enclosed ten point contact switch for regulating the D. C. output compensating for any drop in supply line voltage which is sometimes necessary at different periods of the day and also to raise the current for an unusually dark film. The transformer secondary is provided with link connectors having four adjustment positions which are set at the time of installation to suit your particular equipment or requirement.

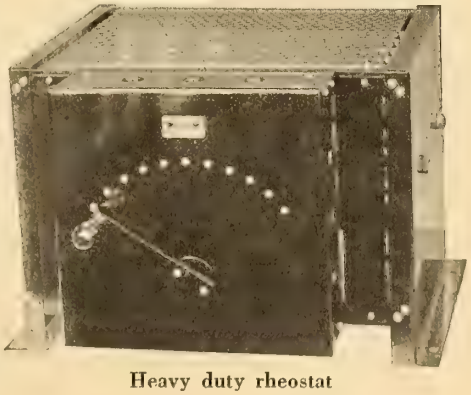
The regulated alternating current is fed to two rectifier tubes of the hot cathode type where due to the properties of the tube and the circuit connections, it is changed to direct current. The direct current from the tubes is now of a pulsating nature and it is necessary to smooth out the pulsations which is accomplished by the two reactances of special design. From the reactance the current flows through an ammeter of the moving coil type which registers the correct value of the current and thence the current passes to the carbons of the arc. The bulbs contain no mercury, are self-starting and require no tilting or starting mechanism, just turn on the A. C. supply and the direct current is ready at the arc.

The Forest Electric Corp., specialists in their line, invite inquiries on technical matters compatabile with their interests.

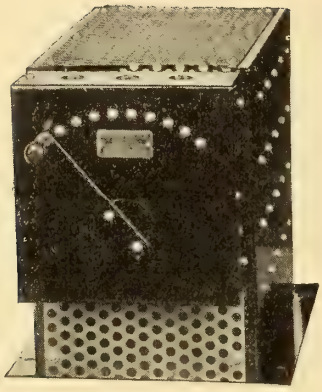
New Line of Schaefer Arc Lamp Rheostats

Schaefer Bros. Co., 1059 West Eleventh Street, Chicago, rheostat manufacturers for many years, recently announced a new line of projector arc lamp rheostats in a catalogue of their products. The arc lamp controllers are built in two types—for light and heavy duty, and each type in generator voltages of 85, 100, and 110 volts. The light-duty type is built with porcelain tube resistances, and the heavy-duty rheostat utilizes grid resistance with which this company has had very good results. The resistance is mounted inside a sturdy iron frame for floor mounting.

A radial sliding brush of laminated



Heavy duty rheostat



Light Duty Rheostat

copper is arranged to slide over a series of contacts mounted on a slate inside a steel box enclosure. The rheostat regulation is designed to vary the arc lamp voltage from 45 to 65 volts. Three terminals are provided, the third being a connection for using the entire resistance bank in the circuit when the arc is being struck.

Knock-outs are provided all around the steel enclosure so that connections may be made from either side, top, or bottom.

SOG Ignal Condensers

As a rule the condenser is treated as a stepchild and is considered too unimportant to merit much attention. It is true that the money expended for condensers is a small item; but it certainly is a most important article in projection. Does not the brilliancy of the light on the screen and the freedom of objectionable color depend on it to a great extent?

The type of condenser now in use is quite different from that of ten years ago. The much greater light of the modern projection machines demands a condenser that does not discolor, and which does not break. Besides, it must be optically correct, of white color and free from striae.

The SOG Ignal condensers are the only one which combine these requirements. They represent genuine optical glass and are made according to the complicated and costly process that real optical glass has to go through. Ignal glass has a constant index of refraction and of dispersion, a feat not possible with regular condenser glass. Ignal glass is thoroughly annealed, which takes a great deal of time to do properly; this, together with certain special ingredients, is responsible for the extreme heat resistancy.

The polishing, too, is done with utmost care by means of pitch (only camera lenses and high grade optics are pitch-polished), and this is another tedious process on account of the very great hardness of the Ignal glass.

All these advantages of SOG condensers are now so generally known that comparatively few theatres do not actually use them, and those houses are mostly the smaller ones, which still employ the old Mazda, or low-intensity lamps.

The recent tendency for real big lamps for the larger motion picture theatres makes still greater demands on condensers; such of parabolic or cylindrical curves require high grade optics. Ignal glass, being genuine optical and heat resisting is the logical one to use for the most exacting demands.

Screen Grid Amplifiers

The increase in the amplifying property of a tube as a result of the screen grid results from the fact that the positive charge on the screen gives the electrons a greater velocity. In the first place it reduces the space charge between the cathode and the screen grid. But the screen grid, being positive, attracts a large number of electrons to itself, and the higher its positive potential the larger the number it attracts.

Control Electron Flow

If the potential is nearly as high as that on the plate it robs the plate of nearly all electrons and there will be practically no plate current. If the potential on the screen is higher than that on the plate, the plate current will be zero. Indeed, there may be a reverse movement of electrons from the plate to the screen. If the screen grid tube is to function properly the screen voltage must always be considerably less than the voltage on the plate, regardless of the voltage drop that may occur in the load impedance in the plate circuit.

It is by virtue of the higher potential on the plate that more electrons are attracted to the plate than to the screen, although the screen has the first chance to take them. Since the screen is positive it will continue to attract the electrons even after they have passed through the meshes of the screen. Only those electrons that have the higher velocities will be able to get to the plate.

The screen helps to increase the plate current only by increasing the velocity before the electrons get to the screen.

Automatic vs. Fixed Line Voltage Regulator

The problem of line voltage fluctuation in the operation of the sound picture equipments has brought various forms of so-called line voltage regulators into existence. Some are claimed to be automatic, while others are claimed to be fixed, and much confusion exists as to the relative merits and meanings of these types.

Briefly, the automatic line voltage regulator is one which varies its resistance in accordance with the applied line voltage, thereby maintaining an approximately even input voltage to the receiver with which it is connected in series. Unless the device is provided with a self-compensating resistance winding, capable of varying its resistance over a wide range in accordance with fluctuating line voltages, it is not an automatic device.

Fixed Voltage Regulator

The fixed line voltage regulator is simply a straight resistance, which reduces the applied line voltage by a given degree due to the series resistance. The resistance remains the same at all times. The voltage drop is therefore more or less the same over a wide range of line voltages. The only purpose of such a device is to protect the receiver against excessive line voltage.

When the line voltage drops down to normal, however, the resistance remains in circuit, hence the equipment receives insufficient voltage for proper operation. In many instances such a device will actually work greater havoc on tubes than its absence, since certain tubes, particularly power and rectifier tubes, operating at insufficient voltage, are apt to arc badly.

With the automatic line voltage regulator, however, when the line voltage drops to normal, the series resistance is reduced to negligible proportions, thereby impressing almost the full line voltage on the equipment.

Pres. Green Says Wages Best Aid in Slump

"For the first time in cyclical unemployment our general wage structure has not been assailed," said William F. Green, president of the A. F. of L., in an address before the convention of the International Brotherhood of Stationary Firemen and Oilers.

"We have preserved our standards during this distressing period," said Mr. Green. "Any reduction in purchasing power which follows a reduction in wages would be injurious not only to the great mass of the people, but to the whole of society. If we are to be brought out of the present industrial depression in a reasonable length of time, we must maintain the purchasing power of the people."

Depression Not Inevitable

President Green challenged the theory of a certain school of economists that recurring periods of unemployment are necessary and inevitable.

'To admit that,' he said, "is to admit that we are incapable of dealing with unemployment. Such an admission would present a most gloomy picture to coming generations."

The trade union executive declared that women must not be sacrificed on the altar of commercialism.

"Men must earn an income annually to protect their women folk and to keep their families in comfort," he said.

Everyday Science

Violet Light in Ocean Depths

Levels of the ocean provided with violet-colored daylight, like a scene in the theatre illuminated with the purest violet light, are reported by Dr. Henry Fairfield Osborn, of the American Museum of Natural History, as a recent discovery of the expedition of the New York Zoological Society now exploring the ocean off Bermuda. Dr. William Beebe, leader of the expedition, and Mr. Otis Barton have made 15 deep-sea dives, Dr. Osborn reports in a communication to the scientific periodical, "Science," some to depths of over 800 feet, using the new steel diving sphere, constructed by Mr. Barton.

Withstood Terrific Pressure

Windows of clear, fused quartz withstood the outside water pressure of over 600 pounds to the square inch and permitted Dr. Beebe and Mr. Barton to look out. Close to the sea's surface they found, the light was ordinary daylight but as the sphere descended all red and yellow colors of the spectrum faded out completely. Next the blue colors faded, leaving nothing out but the pure violet rays at the extreme end of the spectrum where the wave-lengths of light are shortest.

At depths of 700 feet and below the outside world of water still seemed to glow dimly with these extreme, almost colorless violet rays. The effect is due, physicists explain, to the action of tiny suspended particles in the upper layers of the water and even of the water molecules themselves in absorbing the rays of red and yellow and of the spectrum while allowing some of the violet rays to pass.

Artificial Rays Make Garden

An underground garden hidden beneath a British dwelling house but provided with green and healthy grass, with ripening vegetables and with flower beds the equal of any to be seen out-of-doors under natural rain and sun, is the newest marvel of ultraviolet rays recently exhibited at Windsor, England, by Lord and Lady FitzAlan.

An ordinary lightless cellar has been provided with a floor of soil and with sprinklers to produce artificial rain when necessary. From the roof hang large electric lamps which not only produce continuous light almost as powerful as sunlight but emit some of the ultraviolet rays also present in natural sunlight. Lamps of similar type now are used in hospitals to provide the health benefits of the ultraviolet rays.

Seeds are sown in this underground garden precisely as though it were out-of-doors. The seeds sprout, the plants grow, flowers and fruit are produced, just as in the open air but more rapidly, Lord and Lady FitzAlan find, since the basement "sun" can be left on for 24 hours a day and since the temperature in the underground garden is held automatically at the point most suitable for the plants.

Possible Commercial Imports

Use of artificial light in this way may have commercial importance, it is expected, in growing hothouse flowers, fruits or vegetables in the heart of a city, using cellar or sub-basement space not otherwise valuable. Private householders are expected, too, to turn unused coal bins and wine cellars into artificial sunlit gardens, both as places for a pleasant summer tea party of a winter's afternoon and as a practical source of table fruits and vegetables.

Find Substitute for Platinum

Electrical engineers have developed a new metal alloy to be used in places where platinum has heretofore been principally used. This new alloy is said to be much stronger than any other metal at high temperature, which makes it extremely useful in the construction of internal combustion engines, radio tubes, etc.

It was developed in the Westinghouse research laboratories as a substitute for platinum in the manufacture of filaments for radio tubes, which are also extensively used in telephone practice. It was discovered that the new metal was harder to forge than steel and possessed the quality of remaining very tough at high temperatures where most metals lose their strength.

Represents Huge Saving

Already, it is said, the substitution of this metal for platinum is saving $250,000 a month in the manufacture of radio tubes. Platinum costs approximately $180 an ounce, where "konel" can be made for a few dollars a pound. "Konel" filaments in radio tubes last approximately 10 times longer than any other filament heretofore used. Tubes with filaments made of this new metal can be operated at 175 degrees colder than tubes with platinum filaments, but with the same emission, thus providing better reception results.

Platinum alloys are used extensively in the manufacture of telephone equipment to provide wearing surfaces for the millions of contacts constantly used in putting through telephone connections.

Take an interest, I beg you, in those sacred structures which we designate by the expressive term "laboratories." Insist that they multiply and that we adorn them. They are the temples of the future, of wealth, and well-being. It is there that humanity grows, becomes strong, and becomes better. It there learns to read in the works of nature, the works of progress and of universal harmony; though her works are too often those of barbarism, unreason, and destruction.—Pasteur.

Heat Street Cars From Top

Many of the new electric railway cars now being constructed are heated by what is termed a "reverse flow" system wherein the heated air is introduced at the roof and the foul air removed through the car floor, thus insuring an even heat distribution throughout the whole height of the car and a constant stream of fresh, warm air free from all foul odors. The system is controlled thermostatically so that a constant heat may be maintained without attention from the motorman or conductor.

Cold air naturally accumulates on the floor, and this, rather than the warm air, is exhausted, so that less power is necessary to heat the car.

Novel Aerial Beacon Light

On the famous Pharos which marked the harbor of ancient Alexandria there was a mirror, a huge sheet of polished metal, mounted on a promontory and turned in the daytime to reflect the sun's rays; at night it was illuminated by torchlight, and the reflected light of the beacon could be seen for many miles at sea. At Chicago, atop the LaSalle-Wacker Building, there is a new type of beacon which reflects either the sun's rays or the light from neon tubes. The beacon is visible day and night to aviators far from Chicago.

The beacon, differing materially from any now in service, employs eight mirrors, three feet in width by five feet in height and of parabolic cross section. Like a fluted octagonal column in shape, this aviation marker at night sends out beams of red light in eight directions. The hot-cathode neon tubes, invented in the research laboratory of the General Electric Company, are the most efficient sources of red and orange light available. By reason of the high transmission power of light of this distinctive color, such neon lights are visible for many miles.

The beam intensity is increased about 30 times by the parabolic mirrors, with a resulting increase in distance visibility. Two neon tubes are mounted vertically, one above the other, in the focal line of each of the eight parabolic mirrors. At night the

beacon appears to be a huge, eight-point, red compass. The upward light is thought to have considerable advantage over the ordinary type of beacon which often cannot be seen by the aviator flying at high altitudes directly over it.

The angles between the beams of red light are bisected by the 2¾-million candlepower beams of eight 24-inch searchlights set at the base of the beacon and directed slightly above the horizontal. A rotating effect results from the successive blacking out of two opposite white light beams in a counter-clockwise rotation around the circle of searchlights. The red beams remain constant.

New English Safety Film

Reports from England indicate that a very interesting contribution to the rather general search, which has been going on for years for a new film base, has just been made. A description of this base appeared in a recent issue of *The Bioscope*, and is presented in the following paragraphs:

Too often it has been found that a film can be produced for laboratory experiments which is satisfactory as regards non-flammability, freedom from grain and complete transparency, but in actual commercial production has presented unforeseen difficulties. Buckling, shrinkage, obscure chemical reactions and adhesion difficulties with the emulsion have all, on different occasions, proved formidable stumbling blocks in the way of the abolition of our present all too flammable film base.

In point of fact, the very requisite of such a base—non-flammability—has in some instances proved to be a temporary quality, rather than a permanent one, and after processing and storage such films have occasionally developed an undesirable increase in burning qualities, which has been progressive as time went on.

Differs from Acetate Base

It is to be expected, therefore, that any new claims for a non-flam base will be received by the trade with some measure of scepticism. Nevertheless, the announcement we are able to make concerning a new safety film will be read with interest. The tremendous importance of a really good non-flam film to the industy will at all times ensure a sympathetic and even an eager hearing to claims of success in this field. We hope at an early date to be in a position to give first-hand details as to how the product referred to in this announcement stands up to the necessary tests.

The new film is stated to be in no way related to the Cellulose Acetate family, being, in fact, a paper of perfect transparency, having greater physical toughness, durability and longer life than celluloid. What is more important, it will not under an increase of temperature generate explosive gases, nor in combustion (which is only very slow) will it liberate poisonous fumes, as in the case of non-inflammable film of the cellulose acetate group.

Suitable for Sound

Photographically this base is said to lend itself perfectly to modern laboratory treatment in the matter of coating (negative and positive), printing, developing, toning and colouring, and, moreover, the purity of the base renders it admirable for sound recording purposes.

We are informed that the company intends to enter the field on terms of competitive equality with celluloid.

In a statement to our representative, Mr. C. B. Hogg, managing director of the company, said: "Several important features have always militated against the wider use of non-inflammable film. In the first place its physical qualities deteriorate rapidly, due to the combined effect of projection heat and mechanical stress. In fact, some brands of which I have had experience actually develop inflammable tendencies after being in use for some time. Secondly, the comparatively high cost of non-inflammable film has always operated seriously against its more general adoption.

Less Expensive

"I feel that we can claim the serious consideration of the motion picture industry for our product on these grounds:

"1. Our positive and negative stock will cost no more than celluloid.

"2. It is just a slow-burning transparent paper and is perfectly safe under all conditions.

"3. It is tougher than celluloid and does not deteriorate or become brittle by usage.

"4. There is nothing in its composition to make it explosive with heat, or poisonous in combustion.

"5. It can be treated photographically in just the same way as celluloid."

Recording Sound on Disc

(*Continued from page* 28)

where the original record bore grooves.

The shell is called a matrix, or sometimes a master negative, and is used to make a few of the familiar black pressings or finished records. In the case of original recordings these records may be used for re-recording, whether preliminary or final, and in the case of final recording they are used in testing the quality of the recording and of the production. For studio uses, therefore, the additional processes corresponding to the printing and developing of a positive film are not necessary, a fact which results in further savings of many thousands of dollars annually.

Two Additional Steps

For the theatre use, however, where thousands of finished records are required, the risk of damaging the original matrix is sufficiently great to justify two additional steps in the process. The matrix is electroplated to derive one or more metal records, sometimes known as mother records, which are in all respects similar to a finished record except that they are composed of metal instead of the familiar black compound. These metal records then become the new source from which are derived by electroplating as many metal negatives, known as stampers, as may be required for use in producing the finished records.

Studio "Dailies"

Fortunately, these electroplating processes, unlike the corresponding sound film processes, have been highly developed by years of experience and may be performed with negligible loss of quality.

The making of records of the "dailies" for studio use involves the use of the original copper matrix as a "stamper." This matrix is placed in a steel die in the record press. Record stock is heated on an adjacent steam table until it becomes quite soft. This stock is then rolled into a plastic ball and placed on the stamper or matrix, which is heated by steam in the dies to much the same temperature as the steam table. The press is then closed, and by means of a hydraulic pressure of more than a ton per square inch the record material is pressed into the minute sound grooves of the matrix. Cold water is then turned into the dies, and after a short interval the press is opened and the record is separated from the matrix. It is then ready for use.

The same operation is repeated as many times as required to provide the desired number of copies. Both in cost and time required the making of these records is very small compared with sound-on-film records.

Theatre Reproducer

In order to re-create sound from a finished record in the theatre, some form of reproducer must be provided which can first convert the wavy groove on the record into electric currents which will be essentially the same in form as those set up by the microphone on the stage. For this purpose a device similar to a recorder, but equipped with a needle instead of a cutting stylus, would serve.

The most important difference lies in the provision of a permanent mag-

net to produce the flux across the armature instead of the electromagnetic field coil used in the recorder. This results in a very desirable simplification of the theatre equipment.

The degree of faithfulness with which the current set up by the reproducer will simulate the recorded current will depend principally upon the electrical characteristics of the recorder and the reproducer. The recorder operates with uniform efficiency over a band of frequencies extending upward to 5,000 cycles, which is about the upper cut-off frequency used in the theatre. At the low-frequency end the recorder efficiency droops in a manner which helps to avoid over-cutting of the wax and at the same time partially compensates for the tendency of the stage and theatre acoustics to over-emphasize the very low frequencies.

Precision Work Required

Some idea of the precision with which this stylus of the recorder must operate may be gained from a consideration of the frequency characteristic and some of the dimensions involved. Since a pitch of 92 is normally employed, the center to center spacing of the grooves on a wax record is about .011 inch. The width of the groove itself is about .006 inch, so that about .005 inch is available for lateral motion of the stylus—half of this amount to either side of the mean position. Since the maximum amplitudes occur at the lower frequencies because of the constant velocity characteristic of the recorder (above 200 cycles) the amplitudes of the higher frequencies will be exceedingly small. Assuming a full cut wax having roughly equal levels of a variety of frequencies present the 200 cycle amplitude will be about .002 inch to either side of the mean. The 1,000 cycle amplitude will be about .0004 inch, 2,000 cycles .0002, and 4,000 cycles about .0001 inch.

Assume then that the volume drops about 20 dbs.— a not uncommon range in talking picture work—and the amplitude of the 4,000 cycle wave becomes .00001 inch, or about ten millionths of an inch.

Electrical Characteristics

The overall characteristic of wax recording must take account also of the electrical characteristics of the reproducer. An additional, but smaller, downward trend toward the high-frequency end results from a mechanical effect which is analogous to film transfer loss. This effect results from the relation between the finite size of the needle point, which must be used in practice, and the length of the waves in the groove representing the higher frequencies, as a result of which the needle tends to bridge over the high-frequency modulations on the wax just as the finite width of the slit used in the film reproducing

(*Continued on page* 38)

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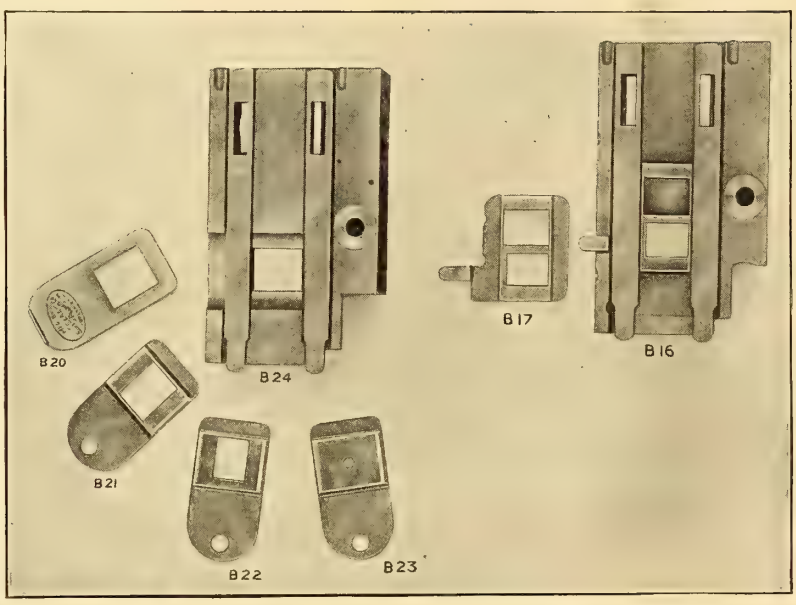
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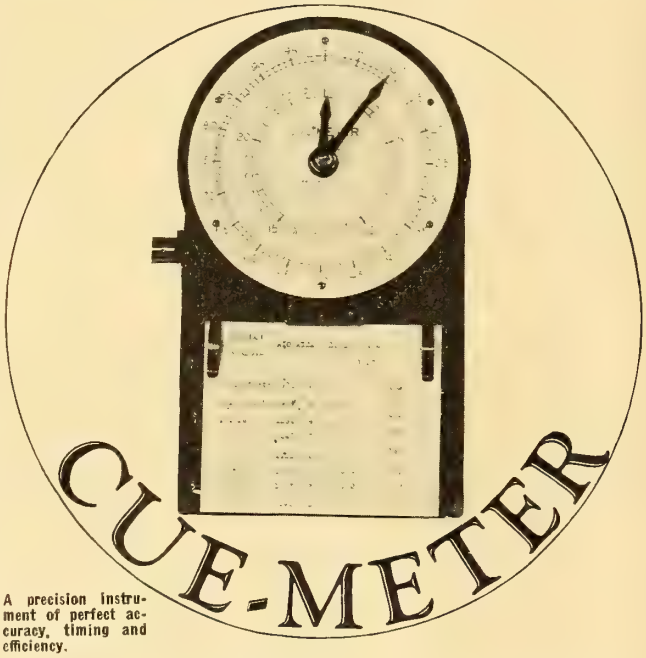
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Types of Motor Drives

THE connection between the driven machines and the motor depends upon many factors, but often the success of the installation hinges upon the method of drive. In every case, the problem should be given careful consideration.

Belts are the most common means of driving machinery and are usually the cheapest. Belts have the disadvantage of being elastic and stretching which causes slipping. Slipping means lost power and often reduced production on the driven machine. The fact that belts will slip is sometimes an advantage, however.

Belts will sometimes cause trouble by coming off under jerky loads and they are not desirable for use at high speeds. Idler pulleys and belt-wrappers can be used where the pulleys are close together, of greatly differing size, or to take up the slack.

Gearing Desirable

Chain belts are positive, and are useful for short-center drives. They will not slip. Sometimes they are noisy and some require considerable lubrication. Chain belts are very popular.

For great speed changes, high speeds and close quarters, gearing is generally desirable. This requires rather rigid supports for motor and driven machines and fairly accurate alignment.

Direct drive through a flexible coupling makes the neatest and simplest installation where the motor speed is the same as that of the driven machine. Often it requires careful aligning, however. For high speeds, direct drives are almost universal.

Speed Requirements

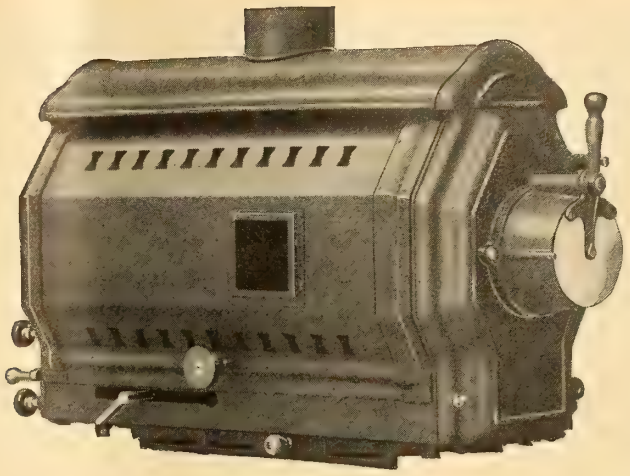
Speed reducers, rope drives, clutches and combination drives find application on special installations.

In planning a motor drive, the speed of the motor should be considered. Always remember that the slower the speed of the motor the larger it will be and the more expensive. Often a high-speed motor can be geared down more cheaply than a low speed motor can be installed to drive directly.

St. Louis Sound School

Members of St. Louis (Mo.), Local Union 143 are attending classes in sound motion picture work every Tuesday at Hibernian Hall. Instruction is under the direction of a professor in a local university, and from time to time the engineers from ranking sound picture companies are invited to discuss a certain problem before the classes.

An encouraging feature of this school is the fact that, while attendance by members is not compulsory, every session attracts practically 100% of the Local enrollment.



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Motor Generator Equipment

STORAGE batteries have to be continually recharged and replaced, which is generally bothersome and expensive. Since the average theatre is furnished with alternating current power, which cannot be directly used for charging batteries, a charging outfit of some kind must be used to keep the batteries fully charged. Of course, the ideal amplifier is evidently one which would function properly on A. C. However, there are some circuits in the sound projector system which require true direct current. There are plenty of the first type of Western Electric sound projector systems which are still using batteries for the *A*, *H*, *F*, and *B* battery circuits.

The Fox West Coast Theatres were the first to install motor generator sets for the replacement of all batteries. Many projectionists are doubtful about the successful operation of the motor generator sets in connection with the operation of sound projector systems.

Batteries Deficient

It is well known that the projector arc motor generator sets give very little trouble and the theory of the successful operation of the larger motor generator sets can be considered for the smaller type motor generator sets. Batteries have been the cause of poor quality of reproduction in many instances. For those circuits which require true, direct current, it is much better to install a motor generator set with the proper filter system to filter out the commutation ripple, as this power is constant; whereas, the battery supply discharges gradually with the result that the values of component circuits decrease.

The question has been asked, "Can A. C. be used for the plate circuit of an amplifier?" It should be noted that the plate of any vacuum tube is always positively charged. If it was attempted to use raw alternating current supply for the plate supply, without rectification, the output signal would be unintelligible, due to the continual change and reversal of polarity.

Charge and Discharge

Will any serious damage be encountered to the plates of a storage battery if the voltage of each cell drops below 2 volts? In the operation of a storage battery the discharge must not go so far that the voltage becomes abnormally low. Under no condition should discharge be continued when the voltage drops to 1.7 volts per cell. If the current flow from the battery is continued at this voltage, serious and permanent damages will result from oversulphation of the plates.

It is well known that the proportion of acid in the electrolyte will give an indication of the condition of the battery, whether it is properly charged or nearly discharged. The acid is much heavier than water, and as the proportion of acid in the liquid becomes greater, the weight of the electrolyte becomes greater. Therefore, the heavier the electrolyte, the more nearly charged the battery is known to be.

Noisy Reproduction

Sound on film requires greater attention than sound on disc. The two 45-volt dry B-batteries, which supply plate potential for the photo-electric cell amplifier tubes and which also supply potential for the photo-electric cell, have given considerable trouble. Exhausted B-batteries cause weak, distorted and wavering Movietone reproduction. B-batteries, which drop 5 volts, many become noisy and even new batteries may sometimes be noisy.

When intermittent popping and crackling noises are perceptible, with Movietone reproduction, check the condition of the dry B-batteries. Total inaudibility can sometimes be traced to internally open-circuited B-batteries. This may be attributed to one cell being exhausted, or by a

Projectionists....

Progress P A C *Through Understanding*

THE tremendous success of the Projection Advisory Council within the past year has demonstrated the marvelous potentialities of this body as a force for much good in the interests of projection and projectionists. Leaders in every branch of the motion picture industry have lauded the work of the Council, and have predicted for it a long and useful life. President William F. Canavan of the International Alliance has endorsed the aims of the Council and has expressed himself as being highly gratified by the work already accomplished by it.

The amount of good work that can be done by the Council is limited only by the size of its membership and the cooperation tendered the Council by that membership. The Council is your organization, Mr. Projectionist, and its efforts in your behalf will be an accurate reflection of the support you give to it.

In order properly to expand the activities of the Council, an increased membership is desirable at the present time. The membership books of the organization will be kept open until September 15th next for the enrollment of new members.

Projectionists, and all those interested in the advancement of projection, are therefore urged to avail themselves of this opportunity to apply for membership in the Council. Use the blank below to help those who are helping you.

LAURENCE JONES, *Secretary,*
Projection Advisory Council,
Box 98, G. P. O., New York.

I desire to join the Projection Advisory Council. Please send me details and membership application blank.

Signed.....

Street.....City.....State.....

poorly soldered joint between the cell connectors and cell terminals.

When a fuse blows, throw it away. If a blown fuse is mixed with good fuses, perhaps, when trouble occurs, you will pick up the blown fuse, which will cause considerable delay.

Amplifier Tubes

Most of the trouble with sound reproduction has been with amplifier tubes. Many theatres are trying to get too many burning hours out of vacuum tubes, with the result of distorted output.

When reproduction is distorted and fringy, check the power amplifier tubes. With those sound reproducing systems using batteries, fringy distortion is often caused by rundown batteries. The Western Electric 43-A amplifier, which employs 211-E vacuum tubes, must be watched very carefully.

This amplifier is not provided with a filament control, such as is provided with the 10-A amplifier. If such were the case, there would be fewer tubes to replace. The filament current for the amplifier and rectifier tubes for the 43-A amplifier is supplied from the secondary of the T-3 transformer. Any increase in line voltage will naturally increase the filament current. The filament current for the 211-E vacuum tubes should not exceed six amperes at a voltage not greater than 10 volts.

The life of the filament is the life of the vacuum tube. The metal of the filament gradually wastes away from continued heating and the filament wire becomes thinner and thinner. This lessens the area of filament surface and there is less electron emission.

Check the line voltage at peak and low periods, have the light and power company install a recording voltmeter to check this situation.

Guide Roller Alignment

It has been found that projectionists are allowing the guide rollers, which are directly above the sound reproducing aperture, to become cut on the inner surface, which allows the film to move sideways at leisure. If the film is allowed to move sideways at the sound reproducing aperture, it is possible that the sprocket perforations will project over in the light source, which passes through the sound track. If such is the case, a ninety-six-cycle hum will be perceptible in the reproduction.

On the other hand, if the film moves sideways, so as to allow the dividing line, which is between the sound track and the picture, and part of the frame line to project into the light source, which passes through the sound track, a motor boating sound will be perceptible. Inspect the condition of the guide rollers and be positively sure that they are in good condition.

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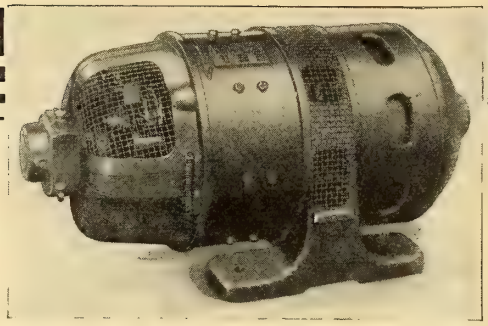
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Recording on Disc

(*Continued from page* 33)

equipment tends to intergrate over the higher frequencies with consequent loss of volume.

The combination of the recorder and reproducer characteristics with this latter effect represents only that portion of the overall frequency characteristic of sound pictures which is contributed by the actual recording and reproducing processes. It does not include such important effects as the acoustics of the stage, the characteristics of the microphone, the amplifiers and the horns and the acoustics of the theatre. Any attempt to compensate for the recording characteristic alone would be worthless. On the other hand the characteristics of the recording system as a whole may be readily adjusted to produce the most pleasing final result in the theatre.

To the low cost of wax negative stock and the needed "prints" or finished records for studio work may be added the important advantage of simplicity of handling. Playing the records in the studio involves devices which almost everyone understands sufficiently to operate intelligently, and which can be readily duplicated throughout the studio to whatever extent is desired. For many purposes a phonograph, modified only as to turntable speed, is sufficient.

In actual recording on the wax disc, practically everything that might affect quality is disclosed during the recording period or immediately afterward by visual inspection of the wax. This is well demonstrated by the fact that much less than one per cent of the records which are processed prove unsatisfactory from a recording standpoint.

Some Difficulties Involved

The disc recording machine has usually been regarded as a stay-at-home machine, resting comfortably on a vibrationless foundation with carefully controlled temperature, dust-free air and other highly special conditions. This is certainly the opposite to a desert location setup with temperatures well above a hundred degrees, and a truck body as the home of the machine. Many records have been made on location under such conditions, with results not distinguishable from studio records. This is a good example of adaptability of disc recording to special conditions.

The cutting of talking pictures represents the most difficult problem encountered in the use of disc records. Special equipment has been provided for cutters, and the use of this equipment has enabled the cutters to work in a very satisfactory manner. Composite records are made of each reel at various stages of the cutting,

which makes the picture and records suitable for any projection room.

In these so-called pre-dupe records opportunity is afforded to approximate the final product in such matters as adding sound effects, and modifying the loudness, thereby giving a better basis for criticism than if the original records were used without any such desired changes.

After the cutting of a picture has been completed, the records corresponding to each reel are re-recorded from the individual "dailies" of original dialogue, songs or other material. This process involves extremely accurate timing of each individual record so that it corresponds with the action of the picture film. It involves the correction of any unwanted variations in loudness of different records, and also occasional intended variation of loudness to correspond with the picture. Sound effects of appropriate nature are added, together with music, for certain scenes. At times the sound on the final record will be a composite of three or more individual records, all properly timed and balanced for relative loudness. The timing is all controlled automatically from predetermined cues.

Disc Advantages

In production work, speed is all-important. At times, delays of even a few seconds seem important, hence it is necessary that recording operations involve nothing that will hold up shooting. Experience shows that recording on disc machines meets this requirement in an entirely satisfactory manner.

It is true that disc recording calls for the use of things which have not heretofore invaded motion-picture studios, but a wax shaving machine or a record press should not be nearly so offensive as a microphone. The former devices are behind the scenes, working so effectively that their presence is never suspected, while the microphone is still regarded with a certain degree of suspicion.

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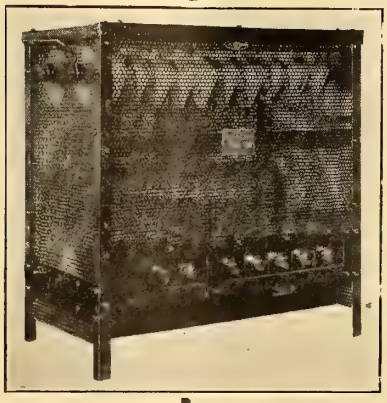
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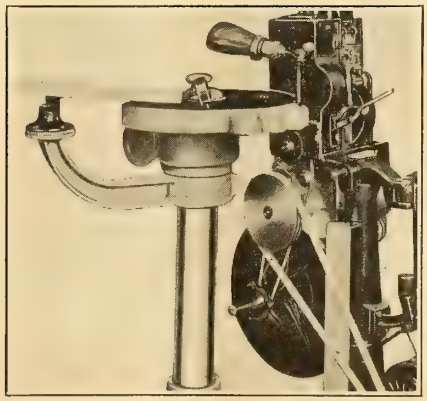
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This Forest Rectifier embodies the use of four rectifier tubes which are connected to supply current to two direct current circuits independent of each other thus preventing loss of current at the first arc when the second arc is struck.

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Hints on Equipment Maintenance

BECAUSE of the rapid advances, amplifiers today are intricate. Consequently, when troubles occur they require the services of competent trained projectionists and engineers. Good, reliable test equipment is necessary. In almost every projection room, where sound equipment is installed, there will be found a portable direct current voltmeter and ammeter, which is usually found in the ERPI spare parts cabinet.

Any measuring instrument will stand a certain amount of abuse; however, it is advisable to see that they have reasonable care to assure the highest degree of accuracy. No matter what the value of the testing instrument may be, it should always be put away in some location that is free from dust, oil, heat, moisture and excessive vibrations.

Expensive testing instruments are often left in a rewind bench drawer among other things, including tools. A container should be provided for testing instruments, which are not in use. There is positively no excuse for the projectionist or engineer abusing testing instruments.

Battery Cells

Many of the first Western Electric sound installations are still receiving their plate potential from storage "B" batteries. Storage "B" batteries consist of twenty-four cells.

Each cell delivers a potential of two volts and each group of cells deliver, when fully charged, forty-eight volts. The storage "B" battery often becomes unusable owing to one or more cells becoming defective. In such cases the defective cell can be shunted out by connecting together the two cells on either side of the defective one. This method, of course, decreases the total output of the battery by two volts.

Such an emergency method of repair will be satisfactory until the defective cell is replaced with a new one. A defective cell can usually be located by using a voltmeter; every good cell will cause the needle to deflect, but a dead cell will, of course, not cause a deflection.

Head Set Testers

Every Western Electric sound installation includes a head set, which is used for testing. Dropping or jarring them tends to destroy the molecular arrangement in the magnet core, with the result that it may become slightly demagnetized. The screw cap on each phone must be kept tight, or rattling and distortion may result.

Constant use often tends to loosen the caps, so that it is well to examine them periodically. If it is necessary to remove the cap and the diaphragm from the phone units, when installing a new cord, or for any other reason, the cap should be unscrewed carefully and the diaphragm slid off from the magnets, instead of pulled off. Pulling the thin diaphragm off is likely to bend it and then it will not work well, making replacement necessary.

Noisy Reproduction

Occasionally it has been found that crackling noises in an amplifier come from a defective resistor. Western Electric amplifiers have many resistors for a certain definite fixed resistance. A defective resistor can be located with a head set, with a "C" battery connected in series.

Noisy reproduction is the most common of all complaints with sound reproducing equipments. It has been found from experience with sound reproducing systems that 70 per cent of all troubles fall fundamentally into the noise category. Noise problems are the most baffling of all to projectionists and servicemen.

Noises in amplifiers usually occur during the performance and they are hard to find. Noise can emanate from so many different sources. Sporadic hissing, crackling and frying noises are usually caused by short circuits developing in vacuum tubes. Crackling and rasping noises are also caused by loose or high resistance connections.

Dirty Tube Tips

When the tube tips and the socket prongs have a film of corrosion over them, the grid and plate circuits are especially apt to be affected, which causes a spluttering or crackling noise. Most of the conductors used in Amplifier circuits are so large that they will seldom if ever be burned out by any amount of current that can reach them.

Burn-outs are generally found in the tube filaments and in the windings of transformers and chokes and broken connections.

On a few occasions it was found that a steady humming sound during the presentation of Movietone sub-

(*Continued on page* 42)

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Three-Dimensional Vision

(*Continued from page* 10)

possibilities of three-dimensional motion pictures. At the present time attempts are being made to adapt the lined screen method to motion pictures. As the time necessary for taking one photograph in still pictures is about 30 seconds, the difficulties are not inconsiderable when compared with motion picture technique, in which 24 exposures are taken per second, based on a speed of 90 feet per minute.

All the various methods evolved for stereoscopic motion pictures use an analyzer in front of the eyes. This is necessarily a tremendous handicap for the successful showing of stereoscopic pictures to large audiences. Until further advances are recorded in this field the practical large scale application of stereoscopy to motion pictures is almost impossible.

The methods invented for actual exhibition purposes may properly be divided into four groups:

Stereoscope Method (U. S. Patents 1,680,242, and 1,276,838): Here the principle of the original stereoscope by Wheatstone and Brewster has been employed. A pair of stereoscopic motion pictures is projected on a screen, side by side, and viewed through a prism, lens, or mirror arrangement to merge the two views.

Anaglyph Method (U. S. Patents 1,729,617, and 1,514,543): In this method red and green colored pictures are alternately projected on a screen. If the red-tinted picture corresponds to the right eye view, and the green picture to the left, a green filter is placed before the right eye and a red filter in front of the left eye. Each eye uses the complementary color to the color of its corresponding picture. Were this not the case, the left- and right-hand views would not be seen by the corresponding eyes and the effect would be an incorrect impression of stereoscopic relief.

Eclipse Method (U. S. Patents 1,435,520, and 1,284,673, and 1,396,-651): As in the former method the two stereoscopic views are alternately projected on the screen, but this time viewed through an electrical vibrator or shutter apparatus held directly in front of the eyes. This shutter is operated in synchronism with the alternations on the screen. The light from the screen is alternately shut off from the left and the right eyes and each will see only its corresponding picture on the screen.

Polarized Light Method (U. S. Patent 1,503,766): Light moves with a transversal motion, similar to the waves in water. Instead of vibrating in only one plane, like water, light waves move in every possible plane. When light is sent through a series of glass plates at an angle it becomes polarized, that is, it no longer vibrates in every possible direction sideways but only in a certain plane, simulating the movement of a cord attached at one end to a fixed point and brought into a wave motion by actuating the other end. This effect has been utilized in the present method by polarizing the light of the right and left views in different planes at an angle of 90°. When seen through corresponding polarizers the picture will appear in actual relief.

Resumé

Reviewing all the various factors involved in the production of stereoscopic vision—to enumerate them: color, shadows, accommodation of the eye lens, movement and displacement of the eye, and binocular vision—we inevitably arrive at the conclusion that the deciding and most effective factor is binocular vision. This fact has been recognized in the practical application to stereoscopic picture apparatus, as all successfully conducted experiments in that direction have been based on the principle of binocular vision.

It is necessary to observe here that all forms of stereoscopic vision demand a certain mental fixation and concentration, and it is evident from the preceding discussion that this is undoubtedly the deciding factor in attaining the concept of depth, even though our sensory reception is only two-dimensional.



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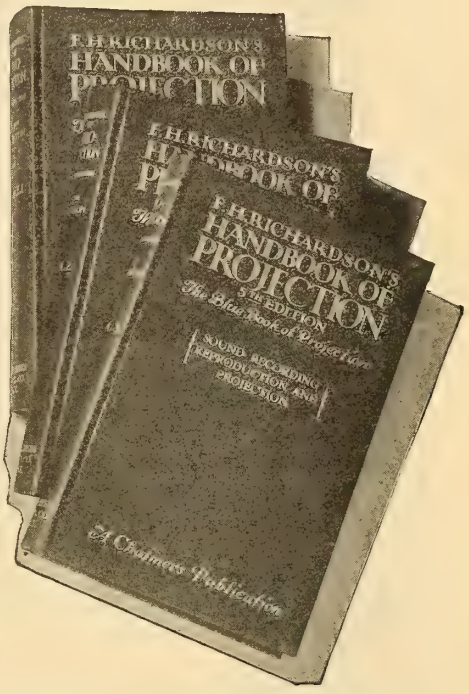
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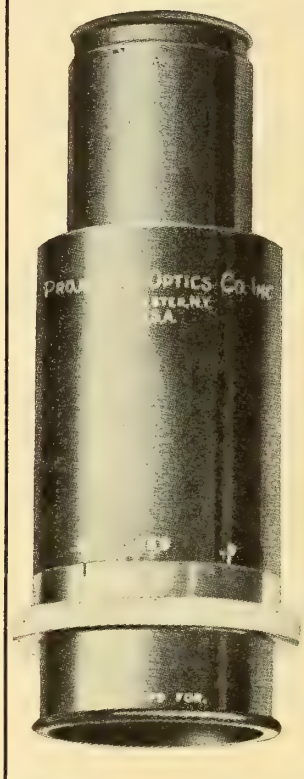
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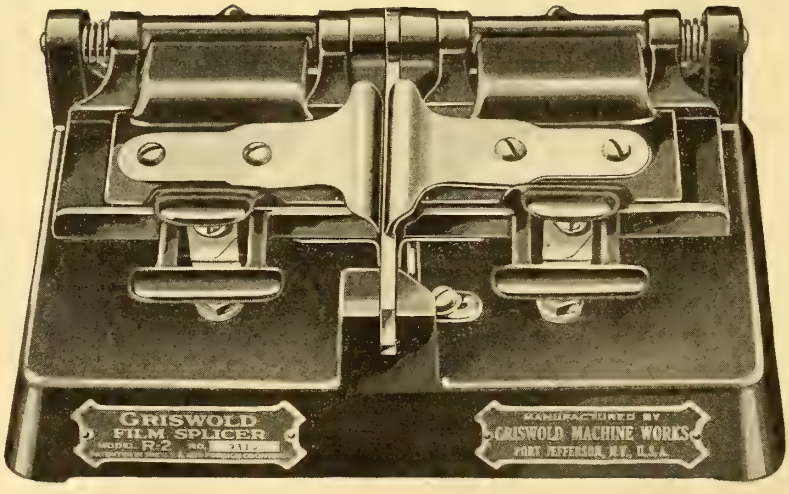
½" and ¾" Variation in E. F.

AS the name implies this new construction offers the projectionist everything he has been looking for; two focal lengths in one construction.

By rotating the ring on the lens mount the size of the image on the screen can be increased or decreased instantly to take care of the difference between sound and silent film. At the same time an automatic shifting of the center of picture on screen with sound film is provided for.

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Hints on Maintenance

(*Continued from page* 40)

jects was caused by a ground in one of the A. C. lighting circuits in the main auditorium. This caused an A. C. hum, which was very perceptible when the fader was set a few points above the normal setting.

Many W. E. sound installations include motor generator sets instead of batteries. Crashing and crackling noises at certain times are caused by dirty commutators and sparking at the brushes. Oftentimes sparking at the commutators indicates a short circuit, or an open circuit, in the armature. A leak or ground on the line may also have the effect of overloading the armature of the generator.

Commutators and Brushes

Commutators and brushes should be inspected at regular intervals. A slow-leaking condenser will cause fuzzy reproduction. The incorrect value of grid leaks and coupling condensers will also cause fuzzy reproduction. Harsh-toned reproduction is caused by increasing the values of grid leaks and coupling condensers. Increasing the filament current, also increasing the plate and grid potentials will cause harsh-toned reproduction.

Crashing and crackling noises during Movietone subjects can usually be traced to dry "B" batteries when they are old and worn out. These dry "B" batteries supply potential for the photo-electric cell and plate potential for the pick-up amplifier.

A. C. hum is many times picked up on this circuit, when this circuit is adjacent to a heavily loaded light or power line, which creates induction.

It has been found, where there were complaints about metallic reproduction, that in most instances defective receivers have been the cause of this trouble. Oftentimes the threaded coupling, which holds the receiver in position, works loose and with the higher frequencies this coupling rattles, which is very perceptible.

Nearly every projectionist or engineer has experienced the time when by touching or tapping the projector it would produce a ringing noise while presenting Movietone subjects. This is a microphonic noise. The Movietone amplifier is mounted and swings on a spring suspension for the main purpose of eliminating vibration. If this amplifier does not swing freely, machine noise will be carried through the reproducing system. If there is a microphonic tube in the first stage of the pick-up amplifier, it will be worse than ever. Inspect the wiring inside of this amplifier as the wiring may be touching the amplifier some place, which will prevent the amplifier from swinging freely.

Crashing and crackling noises can sometimes be traced to a defective power transformer.

"Auricular" Films

Will H. Hays has chosen two new words to describe what have become known as the "talkies." He is pleased to call them, "Auricular Films," and the N. Y. *Times* in commenting on this description says, editorially:

"Ever since the moving pictures began to make use of speech it has been a question how the new production should be called. The public had no difficulty in devising a name. The screen innovation was immediately dubbed the 'talkie.' The word is simple and direct and as accurate as the word 'movie.' But it displays a fatal lack of dignity, and both producers and critics have done their best to find a substitute.

Doubt Term's Popularity

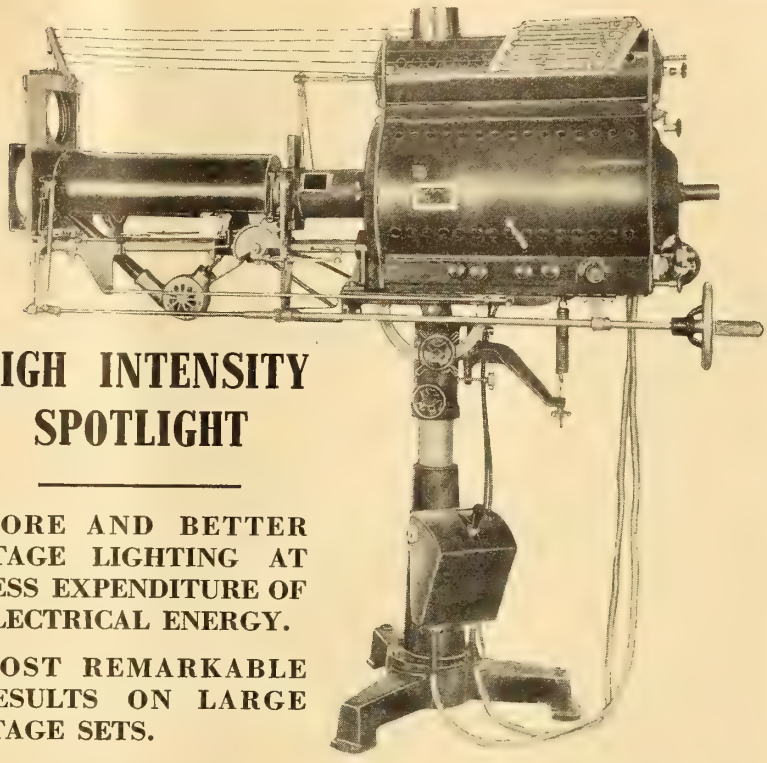
"The term 'audible films' is too long. Now Mr. Will Hays, who holds the motion picture industry in the hollow of his hand, has called them 'auricular films.' We imagine that producers and critics will follow the leader. But we doubt if the public will. The millions who tramp in and out of the screen houses want a single word. They will never call the pictures the 'auriculars.' Like it or not, the name 'talkie' has fastened itself to the film with speech.

"So long as the new invention was in the minority it was necessary to call attention to its distinctive feature. As soon as all houses are wired for sound reproduction, the distinction will have vanished. What is fundamental is that the screen picture is a moving picture. Those who fret at 'talkie' and those who wish to find a more dignified term, such as 'auricular,' may alike cease to worry. Sooner or later the original solecism 'movies' will return to vogue. As before, people will go either to a 'show' or to a 'movie.'"

New Blue Seal Products

Blue Seal Poducts of Brooklyn has kept pace with projector accessories and is manufacturing a new line of heat resisting film traps for Simplex machines. All traps are made of an iron alloy and are guaranteed not to warp under the intense heat of the arc spot, a necessity for perfect projection of sound pictures.

List of the different traps are: Film traps with sliding double round corner apertures, one aperture for disc and silent film and one cut proportional for movietone film to be used with Blue Seal adaptors; sliding double aperture plate; film trap with individual mats for silent, movietone and magnascope effect-traps come with complete mats; master plate to hold the mats stationary; standard aperture with square corners; proportional movietone aperture with square corners, and plank mat.



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The Engineer to the Projectionist:—

(*Continued from page* 17)

laboratories tell us is the best sound practice. Don't experiment. They know—you and I do not.

"I am completely sold on this territory. Again, I enjoy your co-operation."

We trust the engineering laboratories within the industry implicitly, and we know them to number on their staffs some of the finest scientific minds in the world, but we still cannot subscribe to the above viewpoint with regard to the proper function of a projectionist. Experimentation which means but a blundering, harmful disturbance of any of the system's elements, either by itself or in its relation to the rest of the apparatus, should be discouraged. But the arrangement of circuits, the reason for this, that, or the other unit in the system is all legitimate cause for inquiry on the part of the projectionist.

The Projectionist's Viewpoint

In connection with this matter, we should like to present herewith the answer of R. H. McCullough, Supervisor of Projection for Fox West Coast Theatres, to a statement that projectionists are overly inquisitive and cause many interruptions in shows as a result thereof. McCullough said:

"It is my contention that the projectionist working in the theatre cannot possibly know 'too much' about sound reproducing apparatus. The service engineer cannot always be on the spot when trouble occurs, and long and costly interruptions cannot be avoided unless the projectionist is so familiar with the equipment as to be able to make an emergency hook-up. Quite apart from this angle, it is my contention that every piece of equipment in the room should be thoroughly understood by the projectionist. It is his right and his duty to understand every detail of the manufacture and operation of all his equipment.

"Projectionists working under my supervision will do no trusting in any agency but their own knowledge of their work and their equipment and to this end I encourage their absorption of every bit of available information on their work."

Harry Rubin, Publix Supervisor of Projection, has the following to say on the same point:

"The projection room is the projectionist's own little domain, and to my mind he is responsible for the quality of work produced there. No alibis, such as not understanding the details of the equipment, sound or otherwise, or of defective workmanship on the part of the manufacturer, are accepted by me. The projectionist is presumed to know his subject thoroughly, and I expect my men to *know* their room equipments.

"If I expect so much from the men, why should I not encourage their obtaining complete and authoritative information on all phases of their work? I do; and I say further that it is to the benefit of the manufacturers to supply the projectionist with full details on their equipments. Efficient operation is invariably the result of efforts by manufacturers to cooperate with the projectionist in this respect."

Equipments No Mystery

There is nothing mysterious about sound picture equipment. Every unit therein has a reason for being there and results in a certain effect. And projectionists should know both the cause and effect.

We think it a shortsighted policy on the part of any manufacturer to cloak his apparatus with a veil of secrecy, to advise trusting in God, or in the weather, or to luck. Such advice may have been desirable, and even necessary, when sound first was introduced, but the reason for a continuation of such propaganda has long since passed. Projectionists have demonstrated their ability to take sound pictures "in their stride." Besides, present-day projectionists and the sound picture apparatus now installed are going to be around for quite some years to come. Why, then, the secrecy? And when will the lid be lifted?

Our answer is now, right now. Let the flood gates be opened and let every bit of information on sound apparatus sweep out over the country. Let those who wish take it or leave it, as they choose. But let us say that those who choose to leave it will soon be leaving this motion picture business via a one-way exit. Put the proposition squarely up to the projectionist; don't make it possible to alibi faulty sound reproduction.

If this is done, if all restraints are washed away in a cleansing steady flow of information, we'll wager that the industry will see sound reproduction of a quality never thought possible. Give the projectionist his chance, and we'll wager that he will take it "on the fly" and demonstrate his right to be entrusted with this serious business of putting on a good sound picture show day after day.

As for Local Union officers, we might suggest that all addresses given before their memberships be carefully checked-up in advance, so that the men may not be exposed to unjust and harmful propaganda. Cooperation is a grand word; but let us remember the saying that the long, long road is paved with good intentions.



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Sound Reproduction Vastly Improved, Survey Shows

THE quality of sound reproduction in theatres throughout the country, as far as the mechanical operations are concerned, continue to show a steady improvement according to H. M. Wilcox, Operating Manager of Electrical Research Products, who has just returned from a tour of the country including visits to such key cities as Cincinnati, Indianapolis, St. Louis, Kansas City, Pueblo, Denver, Des Moines and Chicago. Of the Western Electric equipped houses inspected during the trip 88 per cent were giving satisfactory sound reproduction at the horn mouth, Mr. Wilcox stated. This compares with percentages of 84 and 76 on the two previous surveys.

"Under the present favorable conditions of steadily increasing co-operation among managers, operators and service men, the outlook is very favorable for 100 per cent satisfactory sound reproduction, as far as the mechanics and operation are concerned, in the near future," Mr. Wilcox asserted. "The public knows the difference between good and bad reproduction. The theatre management knows that the public knows and the result is a complete desire, on the part of all concerned, to obtain and maintain satisfactory reproduction.

Acoustics Need Attention

"As far as theatre acoustics are concerned, there is still a great deal to be desired. In at least one-third of the theatres I visited the sound was not entirely satisfactory, not because of any faults of mechanics or operation but because of acoustical conditions in the theatre. It is to advise and to remedy, as far as possible, such conditions when they are brought to our attention, that we have established a Department of Theatre Acoustics which has already surveyed more than 2,000 theatres in America.

"Until the relation of acoustic conditions to good sound reproduction is fully recognized and until this relationship is taken into consideration both in the construction of new theatres and the equipment and alteration of existing theatres, there will continue to be instances of inadequate reproduction due to theatre acoustics. We have steadfastly urged the need of careful study of acoustic conditions in a theatre and believe that today, it represents one of the most serious problems the theatre owner has to face in adequately presenting good talking pictures.

"As far as box office attendance is concerned I found on this trip, that if you give the public good quality of reproduction and entertaining pictures they will attend. This was convincingly demonstrated at St. Louis where two theatres, that had splendid sound and were showing good audience pictures, had full houses in the midst of a hot spell when most of the theatres in the city were playing to half filled orchestras."



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Film Storage Rules

Apropos of the Cleveland Hospital tragedy caused by X-ray films bursting into flame, is given the report of Professor John C. Olsen of the Brooklyn Polytechnic Institute's department of Chemical Engineering on proper rules for the safe storage of celluloid films. The report says:

"The most dangerous condition of storage for such films is in confined and unventilated spaces, where the gases are not free to escape. This is particularly true of nitrocellulose films.

"As for the acetate films, they do not burn readily, so there would not be any hazard unless these films were also kept near the combustible ones.

"Nitrocellulose films must not be stored where they can become heated to the ignition point.

Produce Three Gases

"Our investigation shows that three highly poisonous gases are produced by the decomposition of the films.

"The toxic gases are carbon monoxide, nitrous fumes and hydrocyanic acid. Add to these acetic acid fumes and hydrocarbons. Acetic acid fumes are irritating to nose, throat and eyes, but are not highly toxic."

Ohio Projection Room Code

A MOTION picture projector is an instrument, machine or device used for the purpose of reflecting or projecting animated pictorial representations or images upon a screen or other surface by means of lights, lenses and films. Every motion picture projector before being operated, except as hereinafter provided, shall be installed in a room, compartment, or booth constructed entirely of fire-resistive and incombustible materials, ventilated as hereinafter prescribed, with all openings equipped with automatic closing devices to insure the immediate closing of all doors and shutters in case of fire within said room, compartment or booth.

Such room, compartment or booth shall be designed, constructed and equipped as follows:

Where one projector is to be installed the room shall be not less than five (5) feet in width, six (6) feet in length, and seven (7) feet in height. Not less than three (3) feet of additional width shall be provided for each projector in addition thereto.

No combustible materials of any character shall be permitted within a motion picture projection room except the films used in the operation of the projector. Flooring shall be of fire-resistive insulating material.

Door opening to the room shall be not larger than two (2) feet in width by six (6) feet in height, and shall be protected by a fire-resistive door of the self-closing type.

Ventilation Requisites

Openings for projection, projectionist's view and for ventilation shall be provided with gravity sliding metal plates not less than one-quarter (¼) inch in thickness, held in position by combustible cords or fusible links, placed in series, so arranged that one of the links is directly over the film or magazine when inside the projector. Plate slides shall be at least twice the height of the opening.

Ventilators not less than ten (10) inches in diameter shall be placed directly over each projector to exhaust the heat generated in the operation of the projector and to afford an outlet for gas and flame in case of fire. Such ventilating conductor pipes shall be of not less than twenty (20) B. & S. gauge sheet metal, riveted together and connection made with a masonry flue or directly to the outside of the building, so arranged that escaping gases or flames will not come in contact with combustible materials, and insulated from all combustible construction by at least four (4) inches of porous, insulating, incombustible materials. No dampers of any kind shall be placed in such ventilators.

Fresh air registers with a combined area equal to the vent outlets shall be provided in the walls of the room and not more than three (3) inches above the floor line. Such supply registers shall be not more than six (6) inches in height and shall be covered with a metal screen or grille and protected by a sliding plate or shutter as above described.

Projector Arrangement

Projectors shall be equipped with feed and take-up reels in metal boxes with flanged or riveted joints, and shall be constructed entirely of metal or other approved incombustible insulating material and shall be so designed as to provide proper ventilation. Arc lights shall be designed and protected in such a manner that sparks will not be emitted from the light while in operation.

Stranded conductors, not less than No. 6 B. & S. gauge or its equivalent, shall be used between the permanent wiring and the lamp. Asbestos insulation shall be used on conductors within or liable to be brought within six (6) inches of the lamp. Stranded conductors shall be provided with approved lugs. Porcelain tubes shall be provided to insulate conductors passing through the case or other part of the projector.

Projector lamps shall be controlled by a double-poled switch and cut-out within easy reach of the projectionist. The room, compartment, or booth shall be adequately lighted by means of electricity, and no other method of lighting will be permitted.

Handling of Film

A motion picture film is a photographic ribbon composed of inflammable nitro-cellulose, non-inflammable acetate-cellulose or other suitable flexible, transparent materials, and used in connection with the projection of motion pictures.

All motion picture films in any theatre, assembly hall, film exchange or other building shall be kept within a room, compartment, or booth constructed as above prescribed, and all extra films shall be kept in metal boxes or containers with tight fitting covers. All rewinding of films shall be done within the room, booth or compartment of like construction and arrangement.

Portable motion picture projectors may be used in assembly halls other than theatres for educational, religious, or ritualistic purposes, with films of acetate-cellulose or the slow-burning type, without the use of a fireproof room, compartment or booth, subject to the approval of the division of factory and building inspection of the department of industrial relations.

* Section 12,600-16, Bulletin No. 102, Ohio State Building Code.

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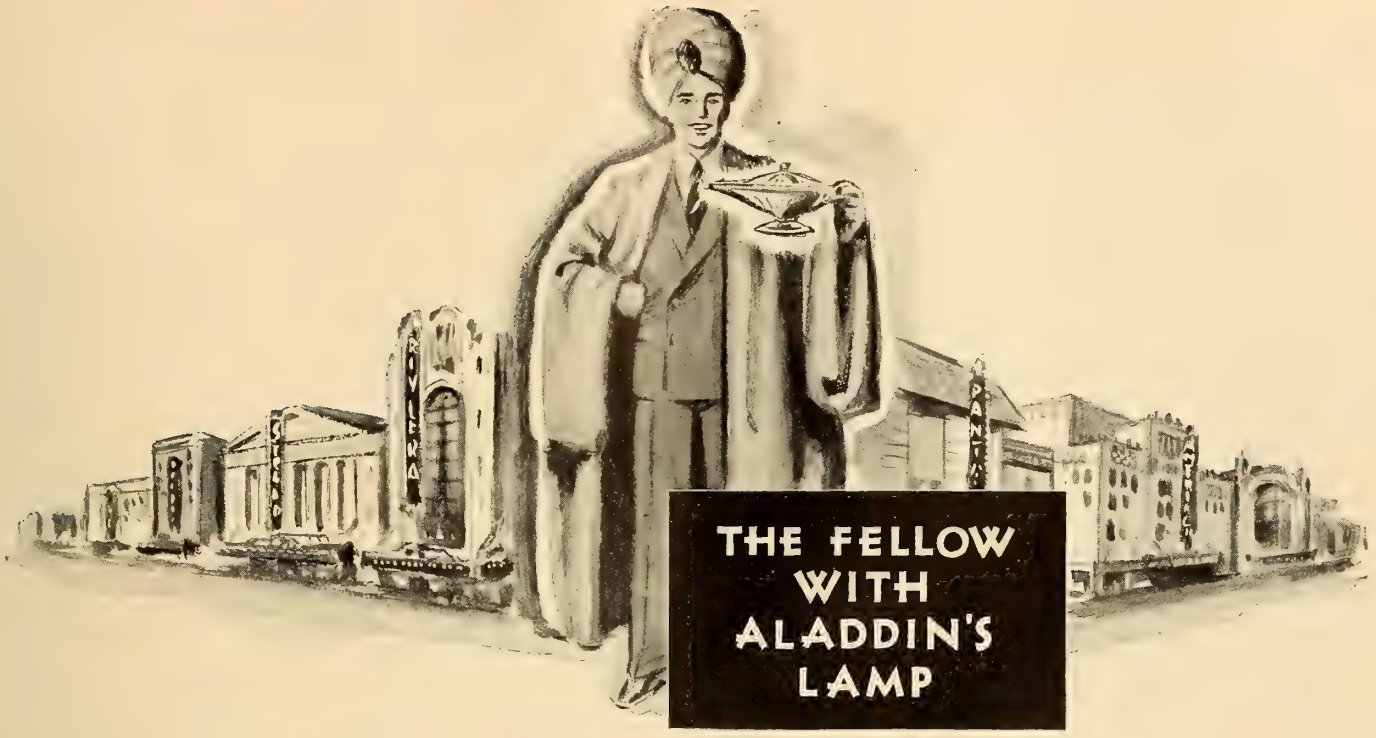
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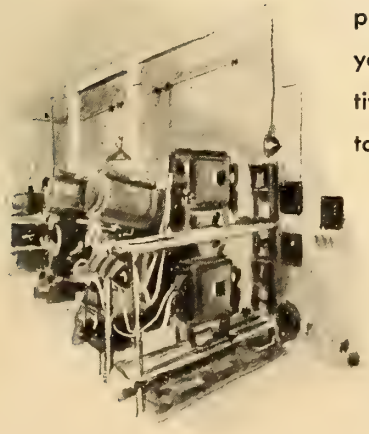
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You remember Aladdin . . . that big Wish and Rub Man from the Orient. One day he saw an old-fashioned lamp in the window of an antique shop. He offered to buy it but the shop owner wanted too much. "Aw g'wan an' die!" says Aladdin, scoring his point with customary politeness. Then he picked up the lamp and the fellow *did* die. Aladdin was delighted. After that he spent his spare time wishing and rubbing. In this way he produced practically everything from a stone-age Packard to his idea of a Night Club, completely equipped except for the cover charge . . . It is frequently pointed out that times do change. Aladdinistic tendencies have sought new outlets. But today, as far as the theatre equipping business is concerned, they still exist—in more rational and far more practical form. Every time your National Representative calls on you, you are talking to a modern Aladdin.

It's true he has traded his lamp for an order book. It's true also that the system is somewhat reversed: (1) He wishes (that you'd use his order book), (2) you use it and (3) he brings you anything you want . . . I don't know whether the quality of Aladdin's lamp-produced merchandise was guaranteed or not. Authorities differ. But this Modern Aladdin guarantees his. Every bit of it. And back of his guarantee stands the integrity, the financial power, the intelligent organization of the largest theatre equipping company in the world. Further than that, this Aladdin of today is a walking source-book of accurate information covering theatre equipment, present and future. His mind is full of today's necessities, his eyes are on tomorrow's trend and his vision is clear. He'll help you correlate the two. He'll keep you abreast of the times. He'll lead you to tomorrow's profits.





Wherever you see it, this stamp of approval means highest quality, thorough practicability and a fair price.

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The International Authority

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LENS FOR SOUND EQUIPPED
THEATRES

PROJECTIONISTS find that the unerring performance and proved efficiency of the Ilex Dual Focus Lens make it a recognized necessity for sound equipped theatres. The burden of perfect projection is lightened and results are doubly effective through the use of this lens.

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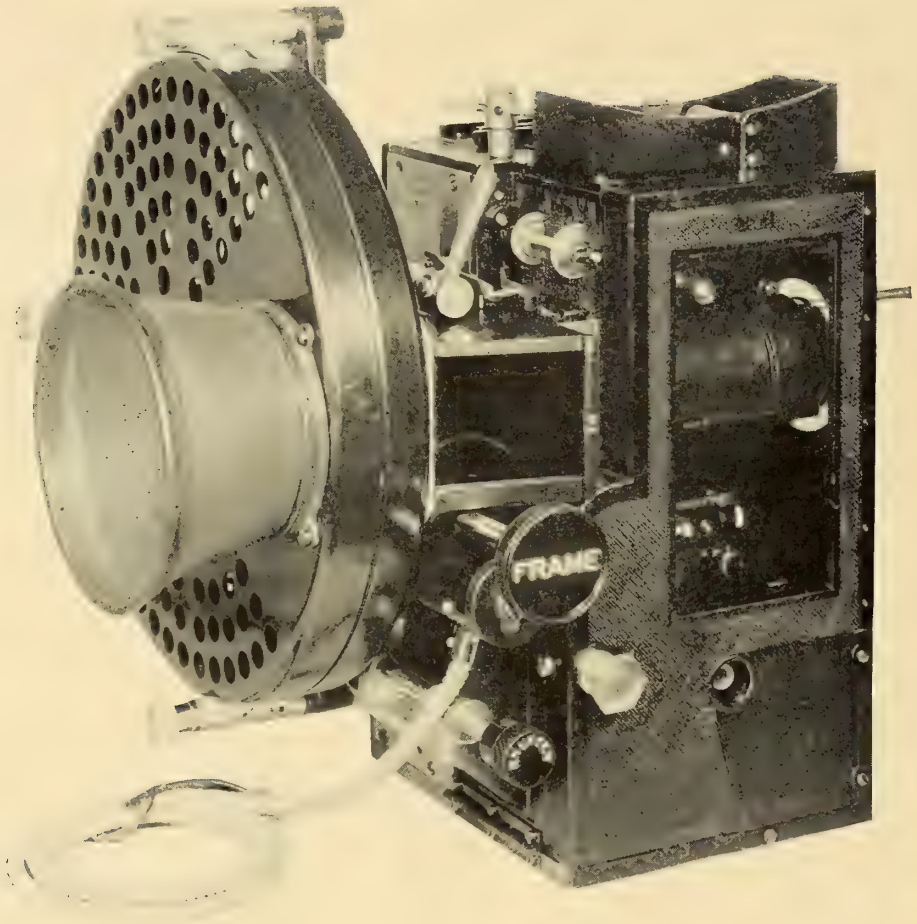
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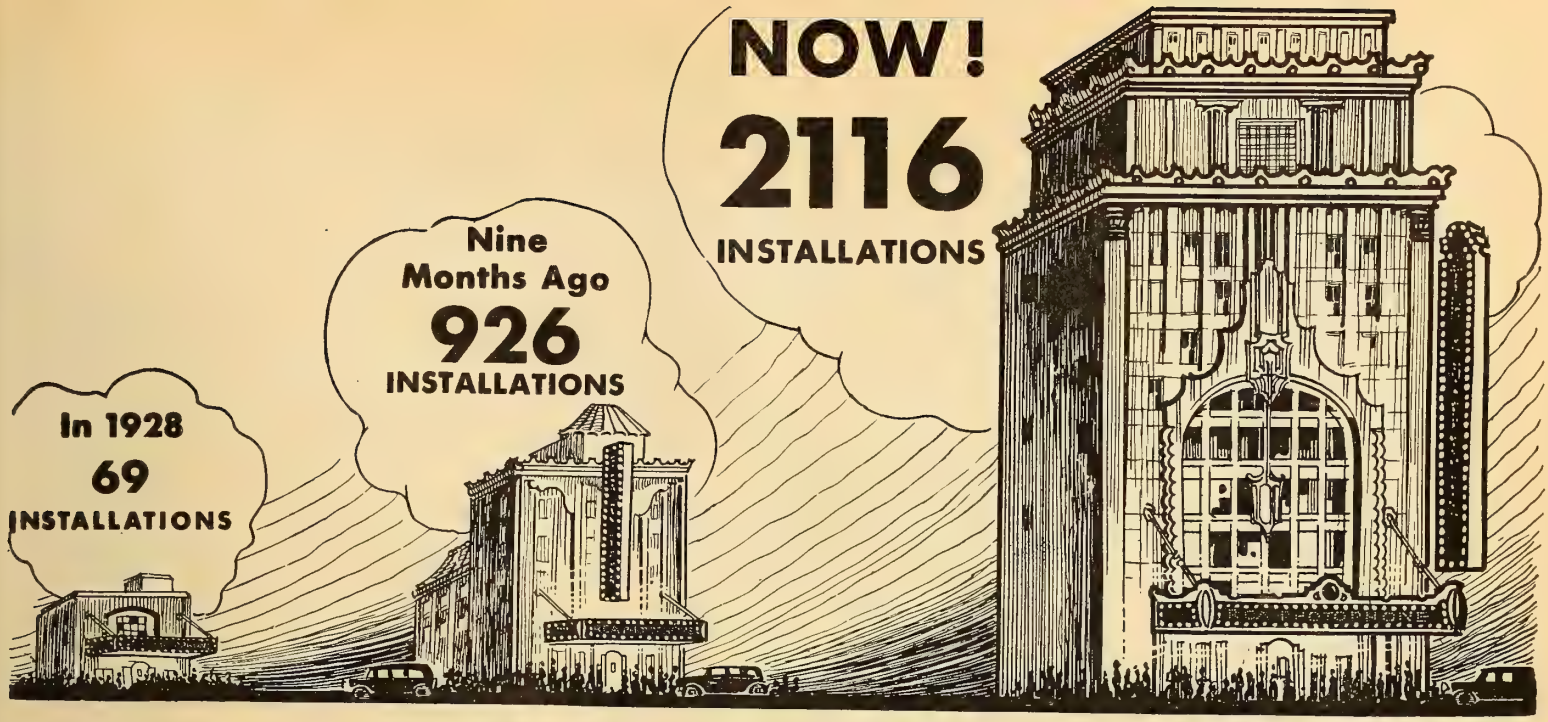
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RCA PHOTOPHONE has brought to thousands of theatres, large and small, a perfection in sound reproduction that is the logical result of the unmatched resources, the unrivaled engineering genius, the strength and stability of the world's greatest electrical and acoustical organizations.

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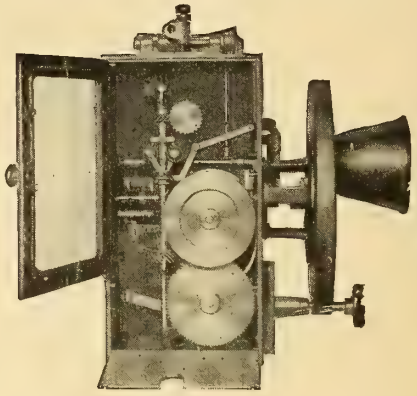
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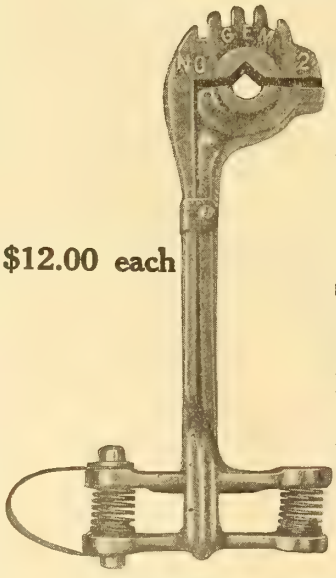
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MOTION PICTURE PROJECTIONIST

October, 1930 Vol. 3, No. 12

JAMES J. FINN, Editor

Lester Isaac, *Efficiency;* J. H. Kurlander, *Light;* Arthur Gray, *Conservation;* John Kieley, *Equipment;* Samuel Wein, *Research;* R. H. McCullough, *Sound Projection;* Harry Rubin, *Improvement;* Victor Welman, *Personnel;* Sidney Burton, *Production.*

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Film Noise Problem

ANY mark in the sound track of the film that is not part of the sound record itself and which causes a change in the light entering the photo-electric cell will give rise to film noise. Film noise results from the sum total of all the markings along the sound track that do not belong there.

Dust and dirt are the most prolific causes of film noise when they pass successfully through the sound gate, in addition to the troubles they cause when they accumulate in the gate. Whether it passes through or collects, dirt is an evil and should be carefully avoided.

Dust may settle on the film during drying in the laboratory and become tightly embedded in the emulsion, it may become attached during processing, or it may come at any of the later handlings that the film is subjected to. The first instances are a laboratory problem; the later ones are a matter entirely in the hands of the projectionists. Finger marks and oil spots also follow from improper care and give loose dirt a foothold in attaching itself to the film.

Scratches in the film may come



Modern films require modern projection

LIGHT from National Projector Carbon arcs can be depended upon to show your pictures more clearly and more satisfactorily. National Projector Carbons provide an extra margin of light that insures a more successful picture from the audience standpoint . . . because the clear, flickerless light from these carbons brings out the scenes in every detail—in all their richness and motion. *And they provide light more economically because they are made to burn more efficiently!* Equip your theater with National Projector Carbons.

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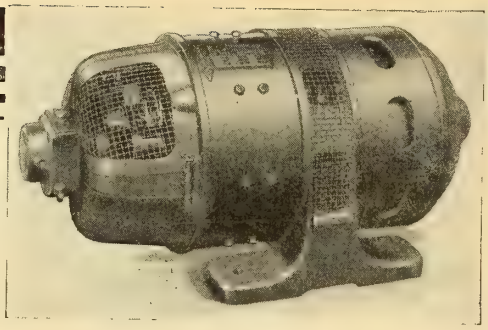
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"THEY KEEP A-RUNNING"

F. S. C. COLORSHEETS

Defy the Heat

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Will not fade **Will not turn brittle**

Samples on request

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from processing, which again is a laboratory problem, or from later handling, again up to the projectionist. The importance of care in rewinding to prevent scratches in the film is very great, and much as may be said on this point it can scarcely be overemphasized. As dirt works in and fills up the scratches they may become the cause of a considerable background of film noise.

Film noise is present throughout as a background to the sound record. It will be most evident when the music or other sound is recorded on the film in small volume and it will be least evident or even unnoticeable when the recorded sound volume is great. However, if loud volume is obtained by boosting the fader setting on a piece recorded very softly, the film noise is also amplified up and may become exceedingly objectionable. Similarly, if there is a section of the film, such as a title, on which there is no sound recorded, the fader should be brought down to zero until the sound resumes, thereby keeping the film noise from becoming evident to the audience.

ERPI Wins "Mixer" Suit

A decision has been handed down by the United States Circuit Court of Appeals of the Third Circuit in Philadelphia in the case of Frederick K. Vreeland and Frank L. Dyer against the Victor Talking Machine Company, which action was based on Vreeland and Dyer United States Patent No. 1,593,735 dated July 27, 1926, for "Art of Recording Sounds."

This action, which related to the "mixing" arrangement for using a plurality of independent microphones or sound pick-ups with a single recording circuit, has been defended throughout by the Electrical Research Products, Inc., on behalf of the Victor Talking Machine Company in view of the recording license from the Products Company to the Victor Company and also in view of the fact that the sound picture licensees of the Products Company make wide use of the mixer panels alleged to have been covered by the patent referred to in their use of recording apparatus supplied them by the Products Company.

The decision of the District Court which was in favor of the patent holding it valid and infringed, has been reversed by the Court of Appeals and the claims of the patent sued on have been held invalid.

S. M. P. E. Fall Meet in N. Y.

The Fall Meeting of the Society of Motion Picture Engineers has been definitely set for New York City on October 20-23, inclusive. The Pennsylvania Hotel will be the headquarters for the Convention. General announcements relative to the meeting as well as a list of papers scheduled for presentation will be forthcoming at a later date.

A PLEDGE

To Theatre Owners, Managers and Projectionists to Maintain

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It has been our responsibility to satisfy the needs of the motion picture industry and to meet many emergencies created during a period of extraordinary expansion and unparalleled activity.

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cost of replacement parts *$1.34*

Peninsula Theatre, Burlingame, Cal.,
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cost of replacement parts *$5.02*

Pantages Theatre, Seattle, Wash.,
operating 2 Fulco Projectors,
One (1) Year and Eight (8) Months,
cost of replacement parts *Nothing*

Pantages Theatre, San Diego, Cal.,
operating 2 Fulco Projectors,
One (1) Year and Six (6) Months
cost of replacement parts *Nothing*

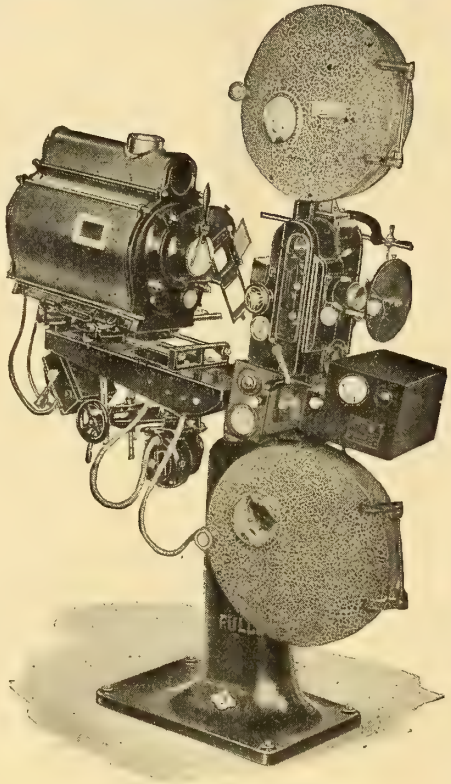
Sun Theatre, York, Nebr.,
operating 2 Fulco Projectors,
One (1) Year and Six (6) Months,
cost of replacement parts *$37.58*

Wellston Theatre, St. Louis, Ill.,
operating 2 Fulco Projectors,
One (1) Year and Four (4) Months,
cost of replacement parts *Nothing*

Hippodrome Theatre, Herrin, Ill.,
operating 2 Fulco Projectors,
One (1) Year,
cost of replacement parts *Nothing*

Hippodrome Theatre, Murphysboro, Ill., operating 2 Fulco Projectors,
One (1) Year,
cost of replacement parts *Nothing*

Bona Fide Facts About Projector ECONOMY



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(Ernemann Design)

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cost of replacement parts *$17.69*

Circle Theatre, Nevada, Iowa,
operating 2 Fulco Projectors,
One (1) Year and Eleven (11) Months,
cost of replacement parts *$4.27*

Pantages Theatre, Salt Lake City, Utah, operating 2 Fulco Projectors,
One (1) Year and Ten (10) Months,
cost of replacement parts *Nothing*

El Camino Theatre, San Rafael, Cal.,
operating 2 Fulco Projectors
One (1) Year and Eight (8) Months,
cost of replacement parts *$1.02*

Parkside Theatre, San Francisco, Cal.,
operating 2 Fulco Projectors,
One (1) Year and Eight (8) Months,
cost of replacement parts *$3.78*

Strand Theatre, San Francisco, Cal.,
operating 2 Fulco Projectors,
One (1) Year and Seven (7) Months,
cost of replacement parts *Nothing*

Dreamland Theatre, Augusta, Ga.,
operating 2 Fulco Projectors,
One (1) Year and Six (6) Months,
cost of replacement parts *$29.98*

Chicago Women's Club, Chicago, Ill.,
operating 2 Fulco Projectors,
One (1) Year and Five (5) Months,
cost of replacement parts *Nothing*

Royal Theatre, Fullerton, Nebr.,
operating 2 Fulco Projectors,
One (1) Year and Four (4) Months,
cost of replacement parts *Nothing*

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Prospects for Non-Intermittent Projection

By ARTHUR J. HOLMAN

PROJECTION is the key function in the process of providing entertainment, amusement and instruction through the medium of motion pictures. The last step in a long series of precise and expensive operations, projection, when performed in the best possible manner, unlocks the stored-up grandeur, unfolding before the eyes of countless numbers the consummate beauty of Nature, the sublime truths of life, and the skill and artistry of actors, directors and cameramen. Every projectionist and every man in any way responsible for projection quality, should strive always to do his level best, for on his work depends, to a large extent, the attractiveness of the presentation; and thereon hangs the success of the motion picture industry.

Man's ability to produce depends very largely on the tools available as well as on his skill in using them, hence the equipment provided for projection is a determining factor in the quality of the presentations. It follows naturally that better and better equipment should be sought and it is the purpose of this article to take you on the quest. Dauntless spirits are forever pushing back frontiers and extending man's knowledge and enjoyment of Nature and her marvelous forces. Thousands of investigators, backed by the resources of large and progressive concerns, are daily delving into the mysteries of Nature and discovering new truths. We are constantly reminded of the fundamental nature of that age-old statement, "the truth shall make you free"; for each discovery added to man's knowledge, makes humanity's burden lighter and thus provides new freedom.

Research men, well-versed in the methods and procedure of original investigation, are familiar with the sensation of "feeling around in the dark" for a lead: they also know what it means to work, perhaps for a long time, on an apparently promising solution of a problem in hand, only to find some unsurmountable difficulty which makes it necessary to start all over in an entirely new direction. Unknown Nature is mysterious and nothing is more fascinating than the digging out of new truths, hence the eternal urge to discovery. With this as a preliminary, let us get back to the problem of finding better means for the projection of motion pictures.

No Basic Improvements

The optical system of modern motion picture projectors may be described as the system of the stereopticon refined and perfected to the Nth degree; the refinements including vast improvements in objectives, light sources and condenser systems. If we but add to this list the one item of mechanical refinement of mechanism, we have a complete statement of the sum total of improvements made in motion picture projecting apparatus since the first projector was conceived. In other words, there has been no basic improvement in the principles of projection since the earliest days of the art.

Just consider for a moment: a gigantic industry, developed from scratch in a little more than thirty years, the very life blood of which must necessarily flow through the box-office in response to the appeal and attractiveness of the industry's product, which can be delivered only through the projection apparatus: and no basic improvements in this apparatus in the history of the industry. What a field for research!

Many and varied have been the attempts at research and development in this field, but investigators, lacking the sympathetic cooperation, encouragement and financial backing of the industry they have endeavored to benefit, have had a hard row to hoe. Before looking into the various inventions intended to provide improved projection principles, it is well to understand the inception of present commercial projectors.

Without intending to belittle or detract from the value of the invention, which is still used universally wherever motion pictures are shown commercially, it is entirely proper to state that the original motion picture projector was nothing more, in principle, than a stereopticon provided with mechanism for intermittently moving the film. The shortcomings, handicaps and disadvantages of this system are well known, but the motion picture industry, having from its birth accepted intermittent movement as inevitable, has paid little attention to the possibilities of continuous projection.

After Wide Film—What?

Commercial intermittent projectors of the best manufacture are marvels of accuracy, and, when properly handled, will deliver about all that can be reasonably expected of machines using the intermittent system. The advent of wide film has long been heralded and much has been expected of it in the way of improvement, but after all, no new principles are involved, and, once the novelty has worn off, the advantages to accrue to the industry, considering the expense of the change-over, are decidedly questionable. The motion picture industry finds itself, as far as improvements in projection is concerned, in much the same position as the research engineer who has arrived at the dead end of a once promising trail: there is nothing to do but go back and make another start.

Since the earliest conception of motion pictures, many have arrived at this conclusion, and many and varied are the ideas for eliminating the intermittent movement. Urged by the intense desire to use a continuously moving film, some have even suggested the use of an intermittently moved objective or pair of objectives. In the records of the Patent Office one finds everything from the evidently impractical to well-conceived and thoroughly thought-out devices, many of the latter being theoretically correct.

Two Known Methods

To produce a stationary image on a screen from a continuously moving film, it is necessary to include in the projector optical system some element, or series of elements, capable of producing a variable amount of bending of the image rays, the magnitude of the deflections being proportional to the displacement of the film frame from the principal axis of the optical system.

Only two ways of accomplishing this end are known to optical science, namely, reflection and refraction, whereby light rays may be deflected, hence all continuous projectors must employ either moving reflectors or moving lens elements. Reflection, being in general better understood by the average investigator, seemed to offer the easier solution to the problem, consequently all but a very few of the attempts at continuous projection have had reflection as the basic principle. Many were the casualties along this line of endeavor, and, in all the years of intensive work, only one development using the reflecting principle has ever operated commercially.

Mechanism Details

This machine, incidentally, is very interesting; it provides a very quick transition between film frames and operates successfully without any appreciable shutter effect, thereby producing a pleasing image quality. The mechanism, however, includes a cam action, which is required to impart the various compound movements to the reflecting elements. The presence of cams and a plurality of reflecting surfaces, both of which must be maintained at high efficiency, ushers in a whole new series of maintenance problems, and herein lies the

difficulty with all reflecting systems for continuous projection.

Variable refraction (what years of study, designing and experimenting the words recall), or variable bending of a light ray by passage through varying zones of a lens, is the fundamental principle whereon all lens systems function. It is the inherent characteristic of the simpliest as well as the most complicated form of lens. Why should not such a fundamental principle provide a solution to the problem of continuous projection? How can any kind of projection be accomplished without a lens? But how should a movable lens system be designed? What kind of lens elements are required and how shall they be supported and what orbit shall they move through? Will cams be a necessary part of the device? What a problem! Little wonder that few have ever attempted the solution, and herein lies the reason for the delay in completing this development.

The first and most apparent advantage of the movable lens system lies in the elimination of all reflecting elements, which, as we have already seen, are most difficult to maintain at high optical efficiency, not to mention the difficulties of manufacture. A mathematical analysis of the movable lens system revealed the interesting fact that simple rotation provides the required movement for the lens elements, hence no cam action is required; and this is advantage number two and it is mighty important.

Further analysis and considerable experimental work proved that accurate superimposition of images of successive film frames could be secured during a large portion of the picture cycle, thereby permitting a relatively long, smooth dissolving action between film frames. This effect, which is peculiar to and fundamentally characteristic of the revolving lens wheel system, provides the ideal transition between film frames and presents a revelation in motion picture projection quality. Here at last is a fundamentally new principle of projection which opens the way to vast and heretofore undreamed of improvements in motion picture presentations, and this new principle is easily incorporated into a simple, compact and study mechanism which contains no mirrors, prisms or cams, and forever eliminates the necessity for the intermittent movement and shutter. What this will mean to the motion picture industry remains to be seen.

A complete continuous projector, functioning on the variable refraction principle, was demonstrated at the Spring meeting of the S.M.P.E. at Washington, and was described in the August last issue of this publication. This demonstration brought forth much favorable comment and created a disposition on the part of the Society to take up a serious study of the subject of continuous projection. That was the first move, by any organization affiliated with the motion picture industry, to seriously consider the possibilties of non-intermittent projection.

Further investigation by the industry will undoubtedly bring forth greater appreciation of the possibilities of the revolving lens wheel system of projection, and, in the not distant future, the long-sought-for naturalness in motion picture presentations will be an accomplished fact in many theatres.

In Defense of Colored Motion Pictures

By PIERRE MOLS

DURING the last year colored motion pictures have come to the foreground very rapidly and seem to have made a favorable impression on the public. The introduction of color into motion pictures has been under severe criticism, especially among the people directly connected with the industry. This is a phase of any new project.

Color as seen on the screen today has by no means attained perfection. However, it took many years for black and white motion picture photography to achieve its present status, nor has it yet attained perfection. The mechanical difficulties encountered in colored motion picture photography are so many more compared with those in black and white photography that the present result, accomplished by the "two-color processes," is quite remarkable.

The Value of Color

A reproduction on the screen in black and white of intense dramatic action is far from being true to life. A reproduction in black and white of a beautiful painting is not true. Both are impressive and emotional, which qualifies them as works of art; but color intensifies the composition of the masses and lines and the thought-expression, because it gives to the final result the brilliant vibration of the color of nature, which is full of color. Herein lies the value of color.

In black and white we can create beautiful compositions and enhance the emotion and thought of dramatic situations by proper lighting. Through the addition of color, which gives us all the hues and shades of a beautiful setting, our emotions are stirred to a much higher pitch. Every person is emotionally affected by color. By applying the proper color harmonies to dramatic or comedy settings the spectator will be consciously or unconsciously emotionally stirred by the color vibrations, adding considerably to the thought and feeling of the action.

Wrong Application of Color

A great mistake, in my opinion, has been made with regard to the application of color to motion pictures, which also occurred with the introduction of sound. The art of pantomime, which is the art of motion pictures, suffered a great deal when sound was first introduced. Pantomime and action were sacrificed for dialogue, but gradually we are getting back to the point where sound is used to intensify action and pantomime, instead of the reverse.

The same occurred with the introduction of color. The use of it has been badly abused by the producer. The proper application of color harmony has hardly ever been taken into consideration, except in a very few instances. May I state, for instance, parts of "The Rhapsody in Blue," in Paul Whiteman's "King of Jazz." Every spectator was impressed by the beauty of these scenes. This height of beauty could never have been reached by black and white photography, due to the lack of color vibration to each individual.

Unnatural Color Shots

The color in most color pictures has been unnatural in contrast, mainly caused by improper application of color in the settings. For instance, brilliant shades of red have been used extensively in sets and costumes. People seem to be under the impression that the color processes emphasize the brilliancy of the colors in the setting. However, this is not true. With conditions as they are at present, the colors are being actually subdued in the laboratory process, to try to attain natural color values.

Why not use the more subdued and neutralized colors to better advantage? The effect will be more pleasing to the eye and truer to nature and the public will receive colored pictures with yet more enthusiasm.—*The International Photographer.*

Proper Test Leads

Test leads constitute an article that most experimenters see and, having seen, desire to own, but more often than not fail to act on the desire. Test leads should be long, to enable the user to locate the instrument to which they are connected well out of the range of easily dropped heavy tools that all too often break meter crystals.

Insulation Necessary

The leads should be very well insulated and especially so near the prods, to be exceptionally safe to use when making tests on high tension voltage devices, and voltage divided circuits. Why experimenters continue to use old lengths of poorly insulated wire, mostly odds and ends, with perhaps a bare spot here and there, is difficult to understand.

Ask these 15 QUESTIONS *before you buy your new sound equipment!*

1 ***Will I get regular service*** by thoroughly trained engineers to maintain high quality and prevent costly break-downs?

• • •

2 ***Has the company enough installations*** to support an efficient nation-wide service organization for the 10 year life of the contract?

• • •

3 ***Has the equipment a proved performance record*** of less than one interruption per thousand shows in several thousand theatres?

• • •

4 ***Will a real stock of spare parts be available*** nearby and a service engineer on call for immediate emergency service during all theatre hours?

• • •

5 ***Will the patrons of my theatre be satisfied that the quality*** of reproduction is the best and equal to that in deluxe theatres?

• • •

6 ***Will I get engineering supervision*** of my installation equal to that in deluxe theatres?

7 ***Has equipment been designed*** to reproduce the high quality recording of the best pictures?

• • •

8 ***Has the company the resources*** to carry on a large program of research and development to assure constant improvement in recording and reproducing and provide mechanical and electrical devices for future developments in the amusement field?

• • •

9 ***Will my contract protect me*** by immediate free replacements in case of fire?

• • •

10 ***Has the company the stability*** to adequately protect me on all patents?

11 ***Has the company a uniform policy*** and contract for every exhibitor?

• • •

12 ***Will I have acoustical engineering assistance*** to correct structural and other acoustical defects?

• • •

13 ***Will I get advertising accessories*** to cash in on a manufacturer's name popularized by national advertising?

• • •

14 ***Will I be able to arrange easy terms*** so I can pay out of box-office receipts stimulated by quality performance?

• • •

15 ***Will my equipment be an investment*** paying dividends over a period of 10 years—or will I—like 2,000 other exhibitors—soon have to replace it to meet the competition of better quality?

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Proposed New Standard Focal Lengths*

By WILBUR R. RAYTON

Scientific Bureau, Bausch & Lomb Optical Company

IN the early days of motion pictures, projection objectives were supplied in a series of focal lengths which differed from each other by only an eighth of an inch. The burden of making and carrying in stock so great a variety of focal lengths became oppressive for both the manufacturer, and the dealer and, in consequence, the Society at its Chicago meeting in 1917[1] adopted as standard a series of focal lengths in which the interval between numbers was a quarter of an inch. This practice has been followed up to the present day. The only further attention given by the Society to the subject of projection lens focal lengths consisted in adopting a standard permissible tolerance of plus or minus 1 per cent.[2]

At the present time the popular numbers include the range from 4.0 inches to 8.0 inches in focal length. A variation of 0.25 inches in 4.0 inches amounts to 6.25 per cent; in an 8.0 focal length the same change is only half as great per cent or 3.125 per cent. This range of focal lengths is required not so much because of any corresponding range on screen sizes as to accommodate a wide variation in projection distance.

A lens of 4.0 inches focal length will project a 20-foot picture at a distance of about 90 feet. If a change is desired it must be either a 3.75 or a 4.25 inch lens if we take the shortest available focus on either side. The corresponding change in screen size will be about 1.25 feet. If the projection distance is 180 feet it will require an 8.0 inch lens to give the same size picture, and the nearest focal length on either side will permit a variation of picture size of about 0.6 feet. The question arises as to why a minimum variation of picture size which is satisfactory when dealing with a 4.0 inch lens should not be satisfactory if a lens is required of double the focal length. In fact, why should the series of focal lengths be based on an arithmetical increment at all except for convenience in remembering what lenses are available? It would seem much more sensible to make the series of focal lengths a geometrical series in which each focal length differed from the one before it by a fixed ratio.

Under any circumstances this suggestion would merit consideration, but at the present time a new complication is introduced by the deplorable state of affairs introduced by sound motion pictures.

Sound Adds to Problems

It is difficult to imagine just how the solidly entrenched ranks of directors, cinematographers, and exhibitors ever permitted themselves to be manipulated into the position in which they now are as a result of the manner in which the sound-on-film process was developed. The appropriation of that relatively small area on the film for the sound record has played havoc with photography and projection.

From the projectionist's standpoint, the attempt to project from the complete sound-on-film picture requires a movable mask at the screen to hide the empty space otherwise plainly visible and makes the projected picture so nearly square as to be decidedly displeasing. If, on the other hand, a mask is employed in the aperture in the projector to restore the original ratio of height to width either a smaller picture results or a projection lens of shorter focal length must be used. If the latter expedient is adopted we can restore the picture size, to be sure, but the center of it no longer coincides with the center of the screen and the lens must be shifted in a direction perpendicular to its axis to restore the center of the picture to its desired place on the screen. This violates all good optical practice and is responsible for some pretty bad projection.

Ignoring the troubles of the studio, it is easy to see that the sound-on-film process has not filled the life of the projectionist with joy and it is to some degree surprising he has not made a more effective protest.

Film and Disc Projection

To add to his troubles, the careful projectionist who tries to find combinations of focal lengths which will give pictures of the same size from Vitaphone and Movietone or Photophone film finds that in only a few cases is it possible. His film apertures differ in a definite ratio, but available focal lengths differ in an arithmetical progression. The difference in film apertures is 11 per cent., and if projection lenses could always be found which differ in focal length by just this amount he could always project pictures of at least the same size.

A series of focal lengths in which the interval was as great as 11 per cent. would be totally unsatisfactory because of too great change in picture size in passing from one lens to

TABLE I

Proposed Series of Focal Lengths, Interval 5.5 Per Cent.

3.00 in.	4.46 in.	6.62 in.
3.17 in.	4.72 in.	7.01 in.
3.36 in.	4.99 in.	7.42 in.
3.55 in.	5.28 in.	7.85 in.
3.76 in.	5.59 in.	8.31 in.
3.98 in.	5.92 in.	
4.21 in.	6.26 in.	

HARRY C. GRIFFIN

It is with deep regret that the General Office reports the passing of one of the most honored and popular members of the International Alliance, Brother Harry C. Griffin, Secretary of Detroit, Mich., Local No. 38. Our beloved member passed away at a local Detroit hospital on August 19th, following an operation.

Since his initiation into the Detroit organization in November, 1907, Brother Griffin has played a most active part is the progress of his own local union, as well as a wholehearted activity in the affairs of the Alliance. His loss to the Eighth District will be severely felt and his constructive influence sorely missed. At the recent Los Angeles Convention he was re-elected to the office of Delegate to American Federation of Labor Conventions. It is also recalled that Brother Griffin acted in the capacity of Chairman of the Joint Detroit Committee at the 1926 Convention, during which time, in his customary unselfish manner, he spared himself no inconvenience and made every sacrifice that the Delegates might receive every consideration to make their sojourn in Detroit a most pleasant one.

We feel that each and every member of the Alliance, with whom Brother Griffin has come in contact, joins with the official family in extending our sincere condolence and profound sympathy to the bereaved relatives of the deceased.—*I. A. General Bulletin, No.* 254.

*A paper read at the Washington, May, 1930, meeting of the S. M. P. E.

[1]Report by Committee on Optics, Trans. S. M. P. E., No. 4 (1917).

[2]Report of Committee on Standards, May, 1923, Trans. S. M. P. E., No. 16 (1923), p. 314.

the next. Architects and exhibitors would undoubtedly raise violent protest. Two other possibilities exist, however, which should be considered.

The first is to make the series of focal lengths differ by half of the 11 per cent. or 5.5 per cent. This leads to the series shown in Table I wherein each focal length is 5.5 per cent. shorter than the next longer. The constant difference of 5.5 per cent. is matched in the present series at the lens of 4.5 in focal length with a 0.25 in. interval between it and the next number. It would correspond to a change of picture size of about 1.1 ft. in a 20 ft. picture. It leads to a series containing nineteen numbers between 3.00 in. and 8.31 in., inclusive, and seems to the writer adequate.

TABLE II

Proposed Series of Focal Lengths, Interval 4 Per Cent.

3.00 in.	4.25 in.	6.00 in.
3.12 in.	4.41 in.	6.25 in.
3.23 in.	4.58 in.	6.50 in.
3.37 in.	4.75 in.	6.75 in.
3.50 in.	4.95 in.	7.00 in.
3.63 in.	5.15 in.	7.30 in.
3.78 in.	5.34 in.	7.58 in.
3.93 in.	5.56 in.	7.86 in.
4.08 in.	5.79 in.	8.20 in.

The second possibility consists in dividing the 11 per cent. into three parts, making the constant difference one of about 4 per cent. This suggestion leads to the focal lengths set forth in Table II containing twenty-seven focal lengths between 3.00 inches and 8.20 inches, inclusive. The minimum change in picture size computed on the basis of a 20-foot picture would here amount to about 0.8 feet.

The difference between the two is that the manufacturer would have to make, and the dealer to stock, nineteen numbers to cover the range in the one case and twenty-seven in the second case. Since the success of the manufacturer and dealer both is to some extent at least essential to the success of the motion picture industry, it should not overlook the possibilities of economy offered by the first suggestion. For comparison it is to be noted that at the present time there are twenty-two numbers in the series from 3.00 to 8.25 inches. The first proposal involves only three fewer numbers.

Discussion:

Mr. Dubray: What are the permissible variations in focal length?

Mr. Rayton: The Society adopted at one time a variation of 1 per cent from the indicated focus as the maximum permissible tolerance with the provision that if the lens is too long in focus it be marked plus, and if too short it be marked minus.

Mr. Taylor: As one might wish to change from full aperture to reduced aperture, why is it not feasible to use a supplementary lens to increase the magnification in order to cover the original screen area?

Mr. Rayton: That depends on the aperture of the illuminating system. If we are dealing with an illuminant making use of only a small part of the projection lens it will produce passable results. The demand is, however, for more and more light. This will, I think, lead to a demand for projection lenses of greater aperture. With an illuminant that fills the full aperture of such lenses the use of supplementary lenses will cause a noticeable loss in definition.

Survey Shows Big Increase in Sound Pictures

Recently an independent survey of the wired field situation was undertaken in the United States and Canada, which evidenced figures considerably at variance with those previously published. The sound equipment houses totaled 10,234 in the United States, while Canada averaged 362. Installations to be completed this year are approximated at about 4,266. It is expected that suitable for sound installation and this will clean up the field of theatres shows a grand total of 14,682.

Wired Circuit Theatres

The producer - controlled sound houses are distributed over the different circuits in the following manner:

Paramount-Publix	1,013
Fox	601
Warner Brothers	402
R. K. O.	119
Loew's	117
Total	2,252

Those circuits not producer controlled are estimated at 1,213, the total estimate of theatres in all chains being 3,465. The independent wired houses reaching a sum total of 6,769 leaves them in a superior position as compared with the 3,465 included in the chains.

It naturally follows that the producers are just as dependent on the business of the "independent" theatre as the independent producer himself —and this condition will be further emphasized as the remaining 4,266 unwired houses come into line for sound.

Volume Control Prime Reproduction Problem

ONE of the greatest problems that exists today in the struggle to make reproduction as nearly perfect as possible is the tendency to keep the volume too loud, according to H. M. Wilcox, operating manager of Electrical Research Products. While Mr. Wilcox declined to make any estimate of the percentage of theatres in which sound quality is being impaired as a result, he stated that it was sufficiently large to constitute a definite obstacle toward the goal of adequate reproduction in every theatre in the country.

"One of the contributing causes to this condition," Mr. Wilcox explained, "is the fact that many theatre managers try to regulate their sound volume by starting the fader at a louder intensity than will be necessary. From that they expect to lower it until they are satisfied with the volume.

Work Up, Not Down

"The fallacy of this procedure is that the ear, *attuned to over-volume at the start*, becomes volume-proof. Sensitivity is deadened, with the result that the listener is satisfied with the volume before it has actually been diminished to a level that should be used.

"The proper way to regulate volume is to start the fader low and work it up to the proper volume.

"Another trait that is retarding the realization of entirely satisfactory reproduction is the tendency to adjust sound volume to meet the requirements of the worst seats in the house instead of the best. The individual judging volume quality often stands in the rear of the balcony or some other place where good reproduction is notoriously hard to obtain. The volume is adjusted where it is satisfactory to the bearer, there, instead of being adjusted so that it will be satisfactory for the vast majority of the seats.

"The desirability for conservative volume should be obvious. The ground or surface noises, that are part of every talking picture as the phonograph needle's scraching is part of the talking machine is emphasized by volume. This is especially true where there are any silent stretches in the picture. Lower volume, on the other hand, tends to obliterate these noises.

General Improvement

"As we have stated before, reproduction quality and stability of operation are showing a steady improvement. In December, 1928, the service department of Electrical Research Products cleared 1,000 emergency calls among theatres that were then equipped. That represented a call per month per theatre. In July, 1930, the department cleared 480 emergency calls from 4,500 theatres, an average of about one call per theatre per year."

Slits—Basis of a Patent Tangle

With Some Notes on the Recent Decision Rendered in the Ries Patent Case and a Résumé of the General State of the Art

By H. R. VAN DEVENTER

THE U. S. Patent No. 1,607,480 dated November 16, 1926, to E. E. Ries, entitled "Method of Reproducing Photographic Sound Records," was filed May 21, 1913, and was therefore in the Patent Office thirteen years. It contains five claims, all of which were involved in a suit in Equity No. 735 in the District Court of the U. S. for the District of Delaware:—General Talking Pictures Corporation and DeForest Phonofilms, Inc., plaintiffs, again the Stanley Co. of America, defendant.

On June 28, 1930, Judge Morris wrote a memorandum decision saying "That Ries patent, in suit, number 1,607,480, for Method of Reproducing Photographic Sound Records, granted November 16, 1926, is valid and infringed by the defendant." This was one of the last decisions rendered by Judge Morris before leaving the Bench.

Decision An Important One

The usual injunction issued in due course, the defendant filed the customary bond, and the case is now on appeal. Meanwhile, business seems to be proceeding as usual, although the industry is awaiting with interest the final decision in the case. If the patent is sustained, it may have a far-reaching effect on the future of the sound picture industry.

Those who feel that the patent is invalid on account of the prior art believe that new evidence to this effect will be presented in other cases in which the patent will be involved or this evidence may possibly appear in connection with a suit involving the corresponding Canadian patent.

The Ries Claims

On the other hand, those who, with the plaintiffs, believe the patent to be valid, point out that during its stay of thirteen years in the Patent Office, it was subjected to a series of proceedings there and that the claims as finally allowed were allowed in spite of these proceedings, and that also the defendant in the case mentioned above put in a complete and very elaborate history of the prior art and that in spite of this presentation, Judge Morris held the patent valid and infringed.

This patent relates to the use of the so-called "slit." The claims are all method claims and the slit is variously expressed therein. In claim 1, it is termed "a small aperture in alignment with the record band." In claim 2, it is termed "a highly restricted aperture." In claim 3, it is termed "a highly restricted aperture." In claim 4, "a small window aperture," and in claim 5, "a small window aperture."

To obtain a correct idea of what Ries contributed to the art, it is interesting to note the following, which gives a fairly representative picture of the state of the art prior to the time Ries filed in 1913. Some of this data was introduced as evidence in the suit against the Stanley Co. above mentioned.

Re: Fritts and Case

Patent No. 1,203,190 to Fritts is of interest as it was filed in 1880, reposed in the Patent Office for thirty-six years, and issued October 31, 1916. The patent contains 91 claims and discloses various means of recording and reproducing pulsations or variations in sounds and other phenomena. The remaining Fritts patents Nos. 1,203,191, 1,213,613—614, 615 and 616 are all of interest as showing the state of the art prior to Ries.

The Patent No. 1,605,531 to Case filed in 1925 and patented November 2, 1926, is of interest as containing 8 claims on a slot unit in which the dimensions of the sheet metal in which the slot is made is definitely given. See also patents to Case, Nos. 1,605,526, Nov. 2, 1926; 1,605,527, Nov. 2, 1926; 1,605,528, Nov. 2, 1926; 1,605,529, Nov. 2, 1926; 1,605,530, Nov. 2, 1926; and Reissue 16,910, dated March 20, 1928; 1,647,504, dated Nov. 1, 1927.

The Earlier Art

Turning now to what is rather early art, the patent No. 631,558, Aug. 22, 1899, is interesting as showing a phonograph, as it is termed in which the sound record is made on a sensitized strip by means of light. Also patent 364,472 of June 7, 1887. The British patent No. 13,924 of 1906 is also of interest. The article in *Electrical Experimenter* of June, 1913, by Samuel Wein is interesting as referring to the work of Dr. Ernst Ruhmer as published in the *Scientific American* of June 20, 1901; and in July, 1929, the *Motion Picture Projectionist* contained an article referring to Ruhmer's early work and giving some early references which have a bearing on the slit patent situation. In November, 1929, the *Motion Picture Projectionist* contained an article dealing with the work of Eugene A. Lauste, and some references given in this article are of importance.

The International Photographer of August, 1929, contains an article of interest respecting Lauste's work; and *The Bioscope* Service Supplement for October, 24, 1928, contains a further description. Lauste's patent specification No. 18,057 of 1906 is of interest, and the same is reproduced in *American Cinematographer* for Sept., 1928, under the heading "Who Invented Talkies?"

Ruhmer's Noted Work

Ruhmer published elaborate accounts of his work in such papers as *Elektrotechnischen Zeitschrift* in 1905, and actually published a catalog or price list of his sound recording and reproducing apparatus *prior to* 1908. In *Natur und Kultur* published at Munich in 1903 Ruhmer shows and describes his sound recording apparatus, and those who know of his work at this time are emphatic in stating that he *not only employed the slit, but that the results accomplished by him could not be secured without it.*

Slit Dimensions Keypoint

Of course, those who wish to see the Ries patent upheld declare that all of this early work merely proves that no one took the final step that measured the distance between comparative failure and success until Ries appeared, and that the restricted slot of Ries taken in connection with the other elements claimed by him resulted in success where others had failed.

On the other hand, those who do not believe the Ries patent to be valid, believe that the early work of Ruhmer, Lauste, and others disclosed everything used by Ries and that the dimensions of the slit are merely a matter of degree, and even if the narrow slit obtained results not secured with wider ones, that the width of the slit is a matter of degree and is not patentable.

It is thought that a perusal of the patents and other data herein given and the other art referred to in the suit should give those interested a fairly good idea of the state of the art to which the Ries patent relates.

I am indebted to Samuel Wein for the use of his extensive collection of literature respecting the early history of this art in connection with the preparation of these notes.

Efficient Sound Reproduction

By R. H. McCULLOUGH

Supervisor of Projection, Fox West Coast Theatres

COMPLAINTS and interruptions are very detrimental to any theatre. There is a reason for every interruption. There are many outstanding questions yet to be answered, as to the perfection of sound reproducing equipment. However, the secret of good reproduction with the present equipment is due to proper maintenance and careful operation. Inspect, examine, and test sound reproducing equipment before each operation. Make these inspections severe and be positively sure that everything is all right. Regardless of the size, every theatre requires good projection and good sound reproduction.

There are many methods of correcting troubles, thus eliminating interruptions. The more every projectionist knows the easier it will be to locate trouble when it arises. There are many projectionists who are persistently studying and striving for perfection of operation of projection and sound reproducing equipment, which is steadfast allegiance to the exhibitor and the motion picture industry.

205-D Tubes

A request has been received to explain the function of the four 205-D vacuum tubes in the W. E. A. C. motor control cabinet. Of these, one is used to supply rectified current for the field of the pilot alternator. Two of these tubes act as rectifiers supplying current to one winding of a special choke coil.

This coil has a second winding placed in the circuit, which controls the motor brushes. When the current through the first winding is large, the choking action of this coil is not very pronounced, therefore, a relatively large rotor current can pass and the motor can speed up. As the current through the first winding is decreased, the choking action of the coil is increased and hence the motor speed begins to be limited. Therefore the motor speed can be controlled by regulating the output of the rectifier tubes.

Their output depends on the bias supplied to the grids, and this, in turn, is controlled by the fourth vacuum tube which is operated as an amplifier by the tuned circuit. At speeds below 1,200 r.p.m. the grids of the two rectifier tubes have very little negative bias and these tubes, therefore, pass a relatively large current through the first winding of the choke coil. Therefore, a large rotor current circulates, allowing the motor to speed up. At 1,200 r.p.m. the tuned circuit functions, causing the negative bias of the rectifier tubes to be increased.

This decreases their output and causes the choke coil to cut down the rotor current so that no further speed increase can take place. If the speed tends to go above 1,200 r.p.m. this effect becomes still more pronounced.

The A. C. motor control box functions in this manner when the regulating switch is in the "Reg." position. When it is in the "Var." position the tuned circuit is opened and does not function; the vacuum tubes continue in action, however, and the fourth, or amplifier tube, instead of being operated from the tuned circuit, is controlled by means of a variable resistance connected to the control knob, which therefore regulates the speed as desired when it is turned.

Speed Control Motor

The motor used with the A. C. control box is the repulsion type. Such motors have two windings: the stator winding, which is fixed and receives power from the main A. C. supply and the rotor winding which is on the revolving part of the motor and is not connected with the power supply. This winding is connected to a commutator which has two brushes. If these brushes be connected to a circuit so that current can flow from one to the other, then the speed of the motor will depend on the amount of this current; and by so regulating the latter one can regulate the speed of the motor.

Under certain conditions the commutator of a repulsion type motor will become shorted, which will cause the motor to operate at full speed. The commutator must always be kept free from dirt. Never allow the commutator to become rough.

Commutator Cleaner

During my visit to one theatre, I was advised that one projector motor would intermittently speed-up and then slow down to normal. Upon investigation, I found that the projectionist had used emery cloth to clean the commutator, which shorted the commutator bars, thus causing the motor to speed-up beyond control. Never use emery cloth to clean a commutator.

If the commutator requires polishing, use No. 00 sandpaper. However, in many cases, all the commutator needs is a good cleaning. It is advisable to secure a piece of canvas and dampen with carboni, which can be used to clean the commutator, when necessary.

It is imperative to inspect the brushes of each motor weekly. See that they are cleaned so as to allow free action in the holders. Renew weak brush tension springs. Many troubles which are charged to brushes of motors and generators can be traced to the improper application and adjustment that show up in sparking at the commutator. The projectionist should therefore give due consideration to brush adjustment.

Volume and Speed Control

I have found many projectionists who raise the volume to the normal operating point, before the sound projector is up to a speed of 90 feet per minute, with the result that the quality of reproduction is spoiled. It is very important to see that the sound projector is up to the regular operating speed before raising the volume to the normal auditorium level.

Under no circumstances should motion pictures with synchronized voice or music be run at a speed less or greater than 90 feet per minute. The recording speed for 35 mm. film is still 90 feet per minute, and therefore the projection speed should be maintained at this speed at all times. If the projection speed is varied, the quality of reproduction will be spoiled.

General Notes

The wide picture has not gone ahead as rapidly as predicted. No improvements have been noted in stereoscopic cinephotography, but it seems as though television continues to develop. However, exhibitions prove that it is still an experiment

S.M.P.E. on Wide Film

A published report stated that the S.M.P.E. committee set up some months ago to inquire into standardization of wide film would do nothing further, and that the Society would leave this problem to be settled among the producers themselves. Many inquiries were received as the result of this published statement, and an appeal was made to President J. I. Crabtree for a statement as to the official stand of the Society on this matter. President Crabtree's answer follows:

"In reply to your letter of recent date, I don't know where ——— got its information which is very much in error. Our Society is very much concerned with the matter of wide film standards and the subject will receive its fair share of discussion at the Fall Meeting to be held at the Pennsylvania Hotel in New York, October 20-23 inclusive."

for theatrical presentation. The large picture with gigantic proportions is demanded by the public. The quality of color pictures must be improved. There has been a marked improvement in sound reproduction and recording, however, perfection is still pending.

The introduction of the rear projector shutter has reduced materially the warping of film, which has been caused by the intense heat from the projector arc. Warped film will not travel through the projector mechanism in a flat plane, which is extremely necessary for perfect projection. When warped film is run through the projector mechanism, it causes the film to buckle, which causes an in and out of focus effect on the projection screen, and which is very annoying to the audience. During the days when the standard Arc lamp was in use, before Hi-Intensity lamps or reflector lamps were used, very little trouble was encountered with film buckling. This condition is now chronic.

Since the advent of sound, it is more important that motion picture film receive the best of care. Operating the standard projector arc normally at 80 amperes, there is 450 degrees of heat at the aperture. With the 120-ampere, Hi-Intensity Arc there is 700 degrees of heat. With the reflector lamp, which is also termed the Mirror Arc or Low Intensity Arc, operating at 20 amperes, there is 850 degrees of heat.

The Super-Hi-Intensity Arc, operating at 160 amperes produces 980 degrees of heat at the aperture. The Hi-Intensity Reflector Arc, also termed the Hi-Low Arc, operating normally at 72 amperes produces 1175 degrees of heat at the aperture. These different degrees will give an idea how the heat at the projector aperture has increased during the past seven years.

50% Heat Reduction

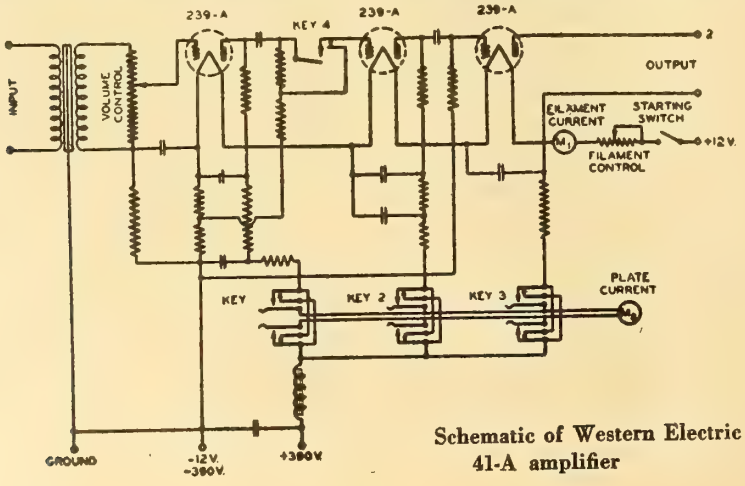
The rear shutter, which can now be installed on the Simplex or Motiograph projector mechanisms, reduces the heat at the aperture approximately 50 per cent, and the film is not warm after passing the aperture. Some theatres have installed a blower system, which blows cool air towards the projector aperture, which reduces the heat about 10 per cent. With the use of the perforated projection screen a certain amount of illumination is sacrificed. It is necessary to make up for this loss, by increasing the amperage, which also increases the heat at the aperture.

Many theatres are now increasing the size of the projection screen, which also requires greater amperage to obtain sufficient illumination. Many of the first-run theatres have installed the Super-Simplex and the new Motiograph mechanisms which are equipped with rear shutters. Other theatres, which have the regular Simplex mechanisms, have had the rear shutters installed for the purpose of reducing the heat at the aperture.

THE Photo-Electric cell amplifier requires greater attention than any other part of the sound reproducing equipment. This is a very feeble circuit and it is important that all connections be absolutely tight; otherwise, a noisy output will result. The Western Electric system employs two sets of "F" batteries, which supply current for the p. e. c. amplifier filaments and also the exciting lamp filaments. One set of batteries usually takes care of two p. e. c. amplifiers, and also two exciting lamps.

We requested, some time ago, that the photo-electric cell amplifier switch remain closed at all times, so as to eliminate the click, which was very perceptible, when closing the switch, during the time the other projector was in operation. The sudden load placed on these batteries caused this click, when the switch was closed. This trouble has been eliminated by separating this supply, so that each projector employing a p. e. c. amplifier would have its own power supply from an individual battery source.

Some time ago, I mentioned that the rheostat controlling the filament circuit of the p. e. c. amplifier should never be varied during the time the amplifier was in operation, as this would cause a crackling noise. There is very little that can be done to overcome this condition, with the exception of being careful, as the amplification is very great at this point, and any slight variation in current by the use of variable resistance will cause a crackling noise.



Schematic of Western Electric 41-A amplifier

Every projectionist should be quite familiar with the fact that the 239-A vacuum tube filaments are connected in series in the W. E. photo-electric cell amplifier and also the W. E. 41-A amplifier. Recently during my visit to a theatre, the sound cut off. I visited the projection room and found the projectionists hunting every place, but the right place for the trouble. The milliammeter on the 41-A amplifier was at zero and one projectionist was testing fuses in the charging panel. The other projectionist blamed the trouble on a loose connection somewhere; in other words, the projection room was a madhouse.

I immediately secured a good 239-A vacuum tube and replaced the dead tube, and the performance continued. On almost every occasion, when the milliammeter on the W. E. photo-electric cell amplifier, or the 41-A amplifier, falls to zero, the trouble can be traced to a burned-out vacuum tube. I have found it to be a practice, if the projectionist does suspect that one of the 239-A vacuum tubes is burned out, that all tubes are replaced in that particular amplifier, instead of finding the dead tube. Locating a dead tube in these circuits is not a difficult job.

Grid Leaks and Condensers

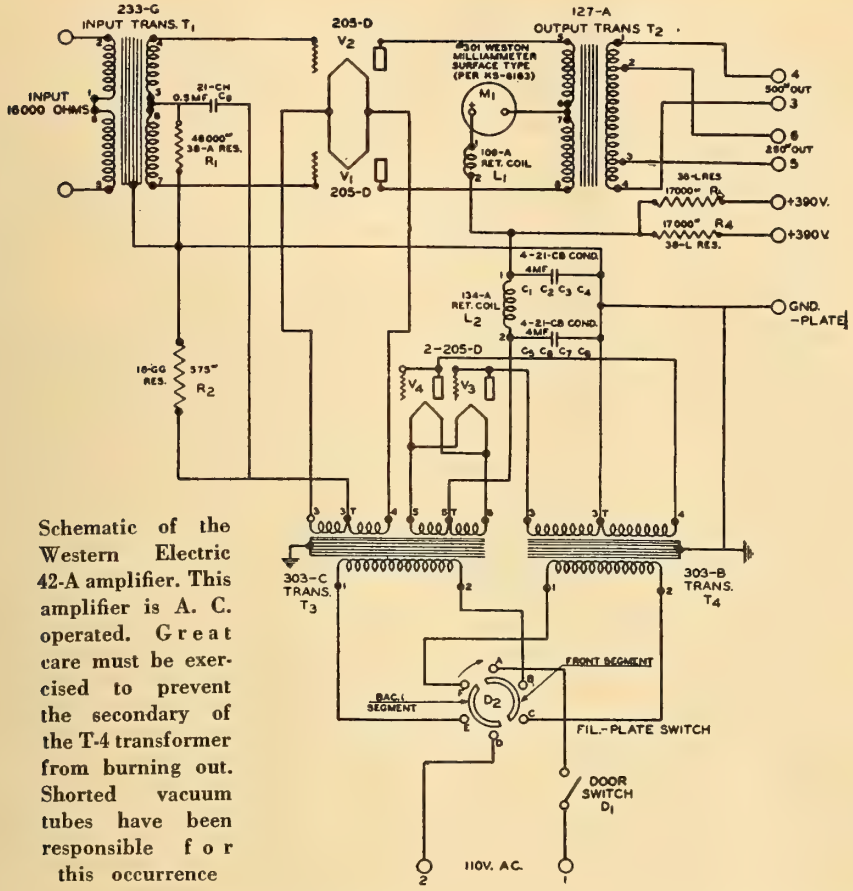
Defective grid leaks and condensers are likely to cause trouble. Distortion, crackling and popping noises can be caused by defective grid leaks and condensers. As the grid element of 239-A vacuum tubes in the p. e. c. amplifier circuit is extremely sensitive and controls the entire action of the tube by letting more or less plate current pass in synchronism with the fluctuations of the voltage applied to it, the grid circuits must be in good condition if satisfactory reproduction is to be expected.

Trouble Shooting Hints

No doubt every projectionist has had the disconcerting experience of having spent considerable time in making repairs and adjustments on sound reproducing equipment. I am relating a few practical experiences, which have happened in the field, and which should be carefully noted.

The Fox Palace Theatre, Wichita, Kansas, reports the following:

"With the exception of replacing tubes, performances have been delayed only for a few minutes. All repairs have been taken care of before or after show time. Have experienced a great deal of trouble in picking up machine noises in the movietone amplifier, which is caused a great many times by microphonic tubes in the amplifier. Had some trouble with a low current reading on the 43-A panel, which was caused by a bad switch located in the front of the 43-A



Schematic of the Western Electric 42-A amplifier. This amplifier is A. C. operated. Great care must be exercised to prevent the secondary of the T-4 transformer from burning out. Shorted vacuum tubes have been responsible for this occurrence

panel. This switch was replaced, which eliminated this trouble."

Most of our troubles are with vacuum tubes. To get the most life from vacuum tubes connected in push-pull it is most important that they be as evenly balanced as possible. These tubes work in pairs, and a tube with low emission on one will throw the load on the other which, in due time, burns out and at the same time gives poor tone quality.

It is always good policy to give the sound reproducing system a daily inspection and test. This inspection consists of cleaning panels, checking tubes, exciting lamps, p. e. cells and batteries, and checking the entire reproducing system.

Voltage Fluctuation

The Fox U. C. Theatre, Berkeley, California, reports the following: "Our main trouble seems to be with power amplifier tubes burning out, which is due to a high A. C. voltage supply averaging from 110 to 121 volts. The projectionists have installed a small bank of resistance in the A. C. line, which keeps the voltage at 110 volts maximum."

The Fox Imperial Theatre, Alliance, Nebraska, reports the following: "A recent trouble with the motor control cabinet was caused by a burned out resistor, which caused the projection speed to increase. This caused no serious trouble or interruption, as the motor control cabinet was set on variable speed until the new resistor was installed." We believe that one of the causes for the resistor burning out was due to the fact that the manufacturer places a metal tag around the resistor with the resistance value stamped on it. This tag causes the heat to concentrate beneath it and thus retains the heat in one spot, which causes deterioration of the resistance wire. We believe this trouble may be eliminated by removing the metal band from around the resistors.

Defective Grid Leaks

The Fox Riverside Theatre, Riverside, California, reports the following: "The Movietone amplifier on the white projector became very noisy. We checked all tubes, photo-electric cell, dry 'B' batteries, etc., but could not locate the trouble. The service engineer was called and, upon his arrival, stated that the photo-electric cell was the cause of the trouble. He also condemned the spare photo-electric cells. New photo-electric cells were obtained, with the result that we still encountered the same trouble. Finally the service engineer replaced the amplifier and still we had the same noise. The dry 'B' batteries were also replaced and still we encountered the same trouble. Finally the grid leaks were tested and one was found to be defective, which caused all the trouble."

The Fox T. & D. Theatre, Oakland, California, reports the following: "Considerable fluctuation was noted on the plate current meters on the main amplifiers whenever rewind or projector motors were started. This was remedied by placing the rewind and projector motors on a separate feed from the main switchboard, leaving the amplifiers and charging panel on a feed by themselves. Chief trouble with the Movietone amplifiers is an occasional microphonic tube. Several power amplifier tubes were lost due to high A. C. line voltage. A resistance was placed in the line, bringing the voltage down to 110 volts—thereby effecting considerable saving in vacuum tubes. Rectifier tubes do not give as many burning hours as amplifier tubes.

A. C. Hum

"We experienced difficulty with A. C. hum from the battery charger particularly at a high fader level making it practically impossible to use the charger during the performance. This was eliminated by re-arranging the lead covered 12-volt Movietone amplifier filament leads as far away as possible from other wires surrounding the charging panel. Popping, due to throwing the Movietone switch in and out, was reduced considerably by turning the exciter lamp rheostat down before pulling the switch."

Keep Contacts Clean

The Fox California Theatre, Pomona, California, reports the following: "We had considerable trouble with the film disc transfer switching panel cutting off, during the presentation of Movietone subjects, due to the cover of the switching panel shorting against the switching keys." It is advisable to keep the contacts of switches in the film disc transfer switching panel clean at all times — otherwise, loss in volume will result.

Condenser Testing

The C-1 coupling condenser .006 M. F. in the W. E. p. e. c. amplifier has given very little trouble—however it may become shorted, and if so, it may be tested in the following manner:—

During the testing of a condenser, always remove or disconnect apparatus in circuit, so that there will be no shunt path around the condenser. In testing the .006 condenser, remove the first vacuum tube in the p. e. c. amplifier, VI, and then remove the two leaks, ½ meg ohm and the 10 meg ohm. This provides a clear path for testing. The condenser should first be completely discharged by holding a wire or piece of metal across its two terminals. This will prevent an erratic test caused by a residual charge.

The two tips of a headphone tester, with a C-battery connected in series, are then touched to the condenser terminals. There will be a click resulting from the sudden formation of a charge on the condenser plates and the accompanying rush of current through the headphones. One of the testing tips is tapped on the same condenser terminal several times.

Sharp clicks should not be heard after the first. A double click indicates a short circuit.

Be very careful not to hold a hot soldering iron on this condenser, as this may ruin the insulation. If this condenser does indicate a short, replace it with another. If you do not have one on hand, go to the nearest radio store and purchase one.

Careful Film Handling

Every manager and projectionist should take active interest in eliminating the warping of motion picture film. However, this cannot be done without additional equipment and some expense. National cooperation in this matter is the only possible way of eliminating this difficulty, which is a general nuisance to those trained for good projection.

Your attention is again called to the careful handling of film. It should be thoroughly understood by this time that film must be handled with the greatest of care. I still find many projectionists who are very negligent in keeping their projector and sound mechanisms clean and free from oil and dirt. I have pointed out before the importance of cleanliness. Dirt and oil on the film sound track will register in the reproduction. It is extremely important that motion picture film be kept perfectly clean at all times. Inspect the projector mechanism; do not allow the sprockets to become undercut. In many cases sprockets may be reversed and additional wear thus obtained. Do not allow the tension springs, which support the tension shoes, against the aperture to be set up too tight. A strain on the sprocket holes of the film will result.

Film varies in thickness and the tension should be checked quite frequently. Idler rollers may not be revolving, and perhaps one of these rollers is responsible for scratching film; maybe they are not lined up and set properly in relation to the sprockets. The fire trap valve rollers in the top and lower magazines should also be checked quite frequently.

Aperture plates and film tracks must be in good condition. The responsibility rests with the projectionist for the condition in which picture film is returned to the exchange.

Great care should be exercised in oiling the projector and sound reproducing mechanism. If too much oil is applied to the bearings, it is possible that this over-flow will find its way into the optical system that focuses the slit on the film sound track. This will result in loss of volume.

(*Continued on page* 46)

How to Properly Care for Lenses

By Sidney Wein*

EXTREME care should be exercised in cleaning projection lenses, for the reason that there are any number of things that may be done incorrectly which result in rendering the lens unfit for further use. One who is inexperienced in cleaning lenses might be expected to proceed as follows: With a handkerchief (soft-laundered or otherwise), he proceeds to rub the front of the lens while it is in the projector head—and it never occurs to him that the lens, to be properly cleaned, should be taken out completely. The procedure on the second lens is similar.

All sorts of cleaning agencies are used—rags, tissue paper, dirty cloths full of grit—in fact, anything which is handy at the moment.

Before any lens is cleaned, or rubbed with any substance, it should be thoroughly dusted with a fine camel-hair brush to remove the hard dust gathered from the lamphouse and the concrete floor. This dust is full of grit and, when rubbed in with a cloth, is an abrasive. A camel-hair brush costs one dollar, but it is worth many times that amount for this purpose.

When a lens is rubbed with cloth or other similar material its surface is practically ruined, as the cloth acts much the same as emery cloth in rubbing *into* the lens the hard dust and dirt which has collected on the surface. Deep ruts in the lens surface result. Before rubbing any lens *always* use a fine hair brush to dispose of the surface dirt.

Use of Liquids

We know that one part of the lens combination consists of two lenses cemented together. If a liquid is used for cleaning purposes, do not soak this lens to clean it. Your liquid cleaner may dissolve the cement on the combination lens, or if there is a slight opening in the cement, the liquid (by this time mixed with the oil and dust on the lens), will seep in and, after it dries, leave a film of oil inside the combination that no amount of rubbing will take out.

Whenever a liquid is used, dampen a very soft cloth and *wipe*, don't rub, the lens, immediately after which the surface should be *wiped* with a piece of fine chamois. Lenses should be polished, and there is a special paper available for this purpose.

In reassembling the lens remember that all bellies (convexes), go to the screen side; all hollows (concaves), and all the flat sides (planos), go to the lamphouse side.

Position Lens Tightly

Inside of the lens barrel there are threaded rings to hold the lenses in place. These rings should be screwed up so tightly that there is absolutely no play. One idea that has had wide circulation and considerable credence attached to it is that lenses, like condensers, must have ample play or they will crack when subjected to heat. This idea has no foundation in fact. The moving film acts as a heat absorbent, and the glass in the lens will not readily crack as a result of the heat that does filter through.

What is more important is that these loose lenses have a tendency to throw the picture in and out of focus and ruin definition. The more the projector vibrates the more the lenses dance in their jackets and the more they are thrown out of line with each other. Such a condition violates every law of optics and the resultant screen picture is anything but complimentary to the projectionist.

Serves As Oil Trap

It will be noticed that the back part of the lens jacket, while holding no lens, has a very fine thread cut through its whole length on the inside. The purpose of this end of the jacket is to prevent oil from splashing on the lens; and the thread on the inside serves the very useful purpose of an oil trap, each thread serving as a little alley in which to imprison any oil that may seep into the jacket and prevent it from rolling down to the lens. Wipe out this section each day with cheesecloth.

Gummed Labels

A gummed label pasted on the film facing you with the number of that reel marked in large type on it and the name of the picture in smaller type (where double features are used), will help to avoid the possibility of picking the wrong reel from the bin when in a hurry. Some absent-minded projectionists even today hang a large "ess" hook on the handle of the bin containing the next reel to be used.

Record Marking

Mark the number of every record in bold figures with a china marking pencil on each disc. When two sound-on-disc features are used the same day, put the name of the feature on the disc together with the number. This will avoid confusion.

Torn Sprocket Holes

When sprocket holes are torn on one or both sides of a film the usual procedure is to cut out all the frames on which the torn sprocket holes are bordering. Where sound-on-disc is used this means putting in the annoying blank film to compensate for the film taken out. A better method is to cut from a transparent leader film a strip about ¼-inch wide to include the whole sprocket holes. Patch this alongside the torn sprocket holes so that hole covers hole properly. This will give a first-class job with no annoying blanks.

*Local Union No. 306, N. Y. City.

Response Curves for Sound Apparatus

By C. H. W. NASON

IN the design of units for sound systems it is essential that perfection of each independnt element be striven for. It was the practice in the radio engineering field up until a year ago to meet the deficiencies in certain classes of equipment with compensating measures at other points in the chain. The lack of low frequency response in amplifier circuits was compensated for by designing dynamic reproducers which had marked resonance in the lower register. So also was it the accepted practice to peak the response characteristic of the amplifying transformers in the higher range so as to compensate for losses encountered in the preliminary circuits of the receiver. Advances in design during recent years gave transformers and tuning circuits which did not have the deficiencies noted above. and it was found desirable to seek for perfection in each unit rather than to attempt the so-called "matched unit" procedure which had been the rule.

Certain manufacturers discovered that the public had become educated to the booming, ill-proportioned bass of the earlier speakers, and this practice was continued until it became evident that the more musically inclined laymen recognized the fallacy of the procedure and would have none of it. Today radio equipment is designed with the logical idea of rendering as faithful as possible a reproduction of the original as is technically possible.

Some months ago James J. Finn wrote a short paragraph concerning the "Perfect Speaker" which attempted to show in a few words just what should be expected of a reproducer. In this note the statement was made that the frequency band between 15 and 15,000 cycles was necessary to the *accurate* delineation of speech and music, but that the human ear could not detect the difference if this range were restricted from the ideal to 30 to 10,000 cycles, and that the change could only be detected by direct comparison with the original should the range be still further restricted to an upper limit of 7,000 cycles. The note also stated briefly that the response should be "flat" over the range covered.

Now comes Frank Reichmann of the Oxford Radio Company with a letter occupying three columns of type which Mr. Finn published in the issue of August last. Mr. Reichmann takes up arms over the statement regarding the "flat" characteristic in a letter so replete with fallacies that it is difficult to realize that it was written by a man old in the practice of the engineering art.

This "Flat" Characteristic

With all the recent propaganda regarding "canned music" in the theater I believe that it is self-evident that the entire chain from microphone to loud speaker should be so perfect as to amount to no chain at all, but to a clear channel from one to the other. I believe that when we mention a flat characteristic we have just that in mind—that no one frequency will come to the audience in an improper relation to the others. There is just one condition under which this premise becomes of a doubtful character.

Under certain conditions it is necessary to offer to the audience a rendition differing in volume or power of sound from the original. In the small theater the recording of a brass band must certainly not be run off with the sound from the loud speaker equivalent in power to the actual output of the band. Also, in a large theater it is necessary to boost the level of ordinary speech so as to have the sound reach the furthest recesses of the house.

In the accompanying illustration (Fig. 1), there are two curves showing the response of the human ear to various frequencies of sound. This figure is drawn bodily from *Speech and Hearing* by Dr. Harvey Fletcher of the Bell Laboratories. For our purpose we will refer to the lower curve which shows the absolute mechanical power required of a sound wave if it is to produce a perceptible effect on the human ear. We are particularly interested in the range between thirty and eight thousand cycles. You will note that the pressure required at eight thousand cycles is a bare fraction of that required at the lowest point in the required range.

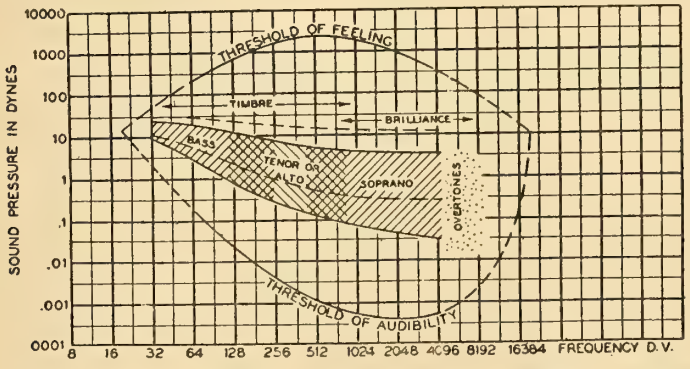


Fig. 1. Relative effect of various sound frequencies upon the human ear. (From Fletcher's "Speech and Hearing," D. Van Nostrand, N. Y.)

If a sound system having an essentially flat characteristic is employed to transfer the sound of a singer from one point to another, and the gain through the circuit is adjusted so that the pressure from the speaker is the same as that from the singer's own vocal apparatus, the reproduction will be the same in all respects as the original. The apparent effect at each frequency is proportional to its pressure—*above the threshold of audibility, not to its actual pressure above zero.* If the singer's voice includes all frequencies over the stated range at an average pressure of one dyne, all the components of the original will be audible. Now suppose we reduce the output from the reproducer so that the average pressure reaching the ear is of the order of .01 dyne. Reference to the curve will show that all frequencies below 192 cycles will be below the limits of audibility and will not be heard. In order to preserve the illusion it will be necessary to so reapportion our electrical circuits as to make the entire band of frequencies have the same proportionate audible effect. It is not enough that they retain their proportionate values with regard to power. In order to preserve the illusion it will be necessary to raise the power output at the low frequencies so that they will be heard in their proper relationship. In the other possible case where the sound output from the reproducer is greater in its average power over the frequency range than the original, it will be necessary to effect a correction by lowering the bass response.

This instance is the only one, other than the well-known cutting off of the higher frequencies to eliminate background noise, which points to the desirability of a response curve deviating from the "flat." Even in this case the correction is necessarily variable, being dependent upon the relationship between the average power of the original sound and that of the reproduction. Such a correc-

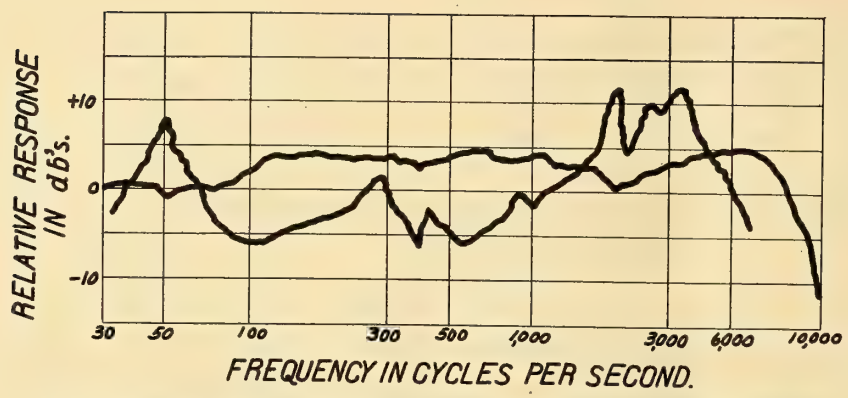


Fig. 2. Showing the relative performance of two loud speakers of the cone type. The superiority of the one with the flatter characteristic is obvious.

tion may be effected by means of networks to be placed in the transmission lines connecting the various elements of the system—but most certainly the desired effect cannot be attained through the use of loud speakers having a response deviating from the truly "flat."

Function of the Speaker

In Fig. 2 we show the response curve of an excellent loud speaker in comparison with one having prominent resonant effects. By "resonance" we have reference to any tendency of the speaker elements to pick up and sustain vibrations of a particular frequency. More correctly, a speaker is not a reproducer, but is a transducer, as it is employed in the change-over of electrical energy to mechanical energy. The rather close interlocking of the electrical and mechanical characteristics of the device give rise to minor resonant effects which account for the "hill and dale" formation of the curve. Just how and why these inter-relationships occur is a matter of interest only to the speaker designer. Returning to the opening paragraph of this paper we might mention the fact that certain of the effects apparent in the curve of the poor speaker might be corrected by a careful design of the amplifier characteristics. With speakers of good quality now available it is of little use to employ poor ones with still poorer amplifiers so as to effect an overall curve in which the deficiencies of one are compensated for by opposite deficiencies in the other.

These curves have been plotted in decibels or TUs. In order to get a more accurate picture of just what is occurring it is sometimes better to plot a curve in "per cent response," the response at some mid-range frequency being taken as 100 per cent. This gives a more distorted curve with alarming aspects where there are truly marked deviations from the normal. Mr. Reichmann takes exception to the use of the "decibel" in plotting curves, but inasmuch as the unit is based on a system quite closely allied with the actual conditions governing the effect of sound wave pressure upon the human ear, the present writer can find no fault with its acceptance as a standard. The decibel represents a power ratio between two quantities and we may readily convert sound, mechanical or electrical power relations into decibels without going through complex mathematical calculation.

It is well to remember that the human ear can barely notice a deviation in sound intensity amounting to two dbs. A falling off of two such units corresponds to a loss of 20 per cent when viewed in the light of the other system. In order that reproduction should be perfect with regard to relative power between frequencies it is essential that a sound reproducing system should be flat within two dbs over the entire range—or within 20 per cent over the range where the use of the other system is deemed preferable.

Relative Current Phases

There is another type of distortion in which the term "flatness" is employed. This has to do with the relative "phase" of the currents. It is a well known fact that dynamic reproducers not of the "horn" type require baffle boards if the lower frequencies are to be reproduced. This is because of the fact that the sound waves from the front of the diaphragm have their greatest relative pressure at the same instant at which those from the rear have their minimum pressure. If the two waves are in such relation one to the other, they are said to be out phase by 180 degrees, and if superimposed would cancel each other. This is exactly what happens unless the air path between the front and rear of the diaphragm is lengthened by the use of a large panel or baffle board. If the panel is not used the lower frequency waves from the two sides of the diaphragm meet in opposite phase and cancel out, killing the low frequency response of the speaker.

In horn type speakers where more than one unit is coupled to each horn, they must be connected in phase or the sound will be completely cancelled out by the conflict between the waves from two units which have their diaphragms vibrating in opposition—even though the vibration of each is violent.

Years ago Hemholtz, whose work in the field of sound is well known to all who have studied elementary physics, stated that the human ear could not differentiate the relative phase of sound waves. Recent developments have proven this to be untrue, and inasmuch as Mr. Reichmann must be willing to admit the rather self-evident truth of the things we have already noted, this last premise must be that which he terms "definition."

When electric currents traverse long transmission lines or complex electrical networks some frequencies are propagated at a greater speed than others. This effect does not become apparent so long as the curve of "delay" or phase displacement as plotted against frequency is a straight line. Should these deviations fail to be a linear function of the frequency a blurring or masking of the speech or music will result. In other words, if there is to be any difference in the time of propagation for waves of varying frequency this difference must assume a practically straight line when plotted against frequency. It is easy to see that waves might readily be overtaken by others traveling at a faster rate and that the complex wave form of speech or music would be altered in the process.

It is not usual that trouble due to this effect occurs in apparatus such as we are considering. The major difficulties of this nature occur in long distance program circuits utilized in national radio broadcasting. The effect may be readily measured for long transmission lines, compact networks, and for devices which represent a complex electrical structure such as dynamic reproducers. Correcting measures take the form of networks or equalizers designed to fit the particular case or a re-design may be necessary in order to retain desirable characteristics while compensating for the delay effect. I merely mention this effect in passing as it is of far too complex a character for the lay mind—indeed, few engineers outside the larger organizations are at all familiar with the effect or its cures.

Introduction of Resonance

When a circuit is resonant at any particular frequency—and I refer to mechanical as well as electrical circuits—there is a tendency to sustain that particular frequency long after the true current has been removed. This is particularly apparent in circuits where the low frequency response has been aided by resonating the primaries of the transformers in the interstage circuits. This amounts to the same type of phase distortion noted above, as currents of the resonant frequency are carried over after the true tone has passed, thus distorting the entire output. If you will listen carefully to the output

from a radio receiver designed to catch the ear with lots of "Boom," you will easily recognize the fact that this particular form of distortion does take place.

This does not mean that the writer condemns the practice of resonating the transformer primaries by means of condensers as a means of improving the coupling at the lower frequencies. Quite to the contrary, this is an admirable practice as by proper proportioning of the circuits the frequency range may also be increased at the high end through this means. The point is that any attempt to add a "pleasing" bass effect by peaking the amplifier or speaker characteristic at the low frequency end will introduce such distortion as to completely destroy the illusion of reality. And that illusion is the quantity for which we are searching.

To be sure—as Mr. Reichmann says—we do not desire to make a poor piano sound like a good one; but neither do we want to render a pleasing but unreal interpretation of any instrument. In order to choose correctly the deviation from the true "flat" response curve which would be desirable for a particular recording, we must have prior knowledge of the power level of the original. Inasmuch as this is hardly possible, we can only determine the best fader setting for each passage and cue the performance accordingly. To choose any particular response curve other than one flat from microphone to reproducer would be worse than futile. We want that poor piano to sound *just like that.*

Mr. Reichmann departs from the true point to demand the response curve of a piano—a violin—and defies Mr. Finn to produce those of a drum or cymbals. Regrettably these items are not in the writer's personal files, but he can upon short notice produce them. Not, of course, response curves but the analysis of the frequency range covered by the fundamental tones and over-tones of the instrument. In further conflict with the views presented by Mr. Reichmann I believe that such an analysis would show just where a Stradivarius violin differs from a cheap modern instrument, and that research work carried out in an intelligent manner might result in the discovery of a method whereby the work of the master could be duplicated.

In no way does the theory of the thing point to any way in which the conclusion that one would not like "to hear a symphony concert where the conductor attempted to sound the high frequencies as loud as the lower frequencies" has anything to do with our discussion of the best response curve for a sound installation. If the conductor was a good one and the composition had been written that way—why, that would be the way I for one would want to hear it played. If I didn't like it, and was certain of the fidelity of the sound apparatus, I would most certainly be charitable enough to conclude that the conductor was a rank amateur, probably a wizard at his own game—the design of high quality reproducers.

From the Projectionist's Viewpoint

A statement which expresses in few words what others have attempted to express in many words is the following contribution of Sidney S. Burton, 1st Vice-President of Projection Advisory Council and President of Chapter 7, American Projection Society to the latter organization's bulletin The Loud Speaker. *Mr. Burton is an outstanding projectionist whose varied experiences in many lines of motion picture work have earned him the respect of the craft and lend authority to his remarks. It is a distinct pleasure to present here Mr. Burton's statement.*—The Editor.

THE Projection Advisory Council in the past has done many wonderful deeds that have assisted the projectionist and his work beyond measure. The Council was formed primarily to place before the press and the public true facts regarding certain productions of which the shortcomings thereof have been blamed entirely upon the projectionist or his equipment.

We of the craft who daily handle the products of various producing companies know that the majority of the shortcomings are not located in the projection reproducing equipment, despite the fact that many so-called "big-shot" studio officials use the projectionist as the final back-stop at which they point their fingers to save their own faces. The projectionist unfortunately occupies the most undesirable position in the motion picture industry in this respect.

Possible Production Faults

After the camera man has shot a scene out of focus or has shot a set crooked, if his lighting has been poor, if his camera had the heebie-jeebies and the film does a Gilda Grey on the screen, you can rest assured that the buck is passed to the projectionist as he is supposed to be a "Dumb Daniel" anyway. If the laboratory under- or over-develops, or if it under- or over-exposes; if the well-known "gamma" of the sound track is not correct; who do you suppose is to blame? No one but the *projectionist!* The poor fish is not supposed to know anything about developing, printing or gamma, so we can slip it over on him if action or sound track density is not up to its proper value.

If a microphone is noisy or a mixer has not washed his ears in the morning, and a film recorder goes haywire, or an actor speaks as if he was trying to gargle a cup of coffee at the same time—guess whose fault it is? You're right, it's the *projectionist's!*

These and a hundred other ridiculous abuses are heaped upon the projectionist and he, being the last one to handle the finished product, has to stand by idly and take it on the chin.

To substantiate what I have here written, I wish to call your attention to one paragraph which I am taking out of the "Technical Digest." This publication is put out by the Academy of Motion Picture Arts and Sciences. The article was written by one of the foremost "technicians" of one of the large studios, as follows:

"While new inventions will improve talking pictures in the future, it is a fact that the quality of recording is considerably better than that of reproduction at the present time. If theatre projectionists would take better care of their equipment, talking pictures would be even more popular than they are."

Detrimental propaganda such as this has been distributed throughout the entire motion picture field by the medium above-named. Its results are that the projectionist is looked upon as a shiftless, brainless individual, unworthy of having an artistic production entrusted to his care.

Support the Council

In order to combat such malicious practise the Projection Advisory Council has been formed to protect the reputation of the projectionist from the buck-passing of a certain few "technicians." To place the blame where it belong and to inform the press and public of the same. Every conscientious projectionist who takes pride in his work should be a member of the Council. The good results already obtained by the Council along this and other lines should make Projectionists' Local Unions all over the country assess their membership about fifty cents per year and contribute this amount to the Projection Advisory Council, as all projectionists profit from the work that is being carried on by it.

As First Vice President of the Council I take this means of urging all projectionists to join and lend their support to the cause. The dues are five dollars per year and is very cheap advertising, approximately ten cents per week, to establish a systematized campaign that will assure us of a square deal.

W. E. Worldwide Installations

Western Electric installations in Great Britain will shortly have passed the 1,000th mark. The figure, according to the last report, is 968. Worldwide Western Electric installations now total 6446 of which 2111 are in the foreign field and 4335 in the United States. Four installations in Switzerland have jumped that country's total to 41.

As The EDITOR Sees It

¶ *Wide Film Standardization*

WIDE film standardization apparently is still a matter of months, due, as we pointed out previously, to a number of reasons, the most important of which are: (1) speculation as to the industry's ability to absorb the tremendous costs involved in a change of standards without serious damage to its standing; (2) the desire on the part of producers to allow a bit more time for a "settling" of sound pictures and colored motion pictures; and (3) the reluctance to spending additional money for equipment at this time on the part of the independent exhibitor, without whose cooperation wide film, or, for that matter, any other change in standards, may not be successfully launched.

To our mind, all this bickering by the industry's technical forces on the matter of standards is so much adroit hedging to gain time. Once the leaders of the industry reach the conclusion that the time is ripe to introduce wide film, we may expect to see a speedy settlement of this standards problem. Three film sizes are now being considered:—56, 65, and 70 mm. The cost of changing specifications on any two of these to meet the other common standard would not be considerable, as these things go. We are of the opinion that 70 mm. will finally win out, and this opinion is not founded on any technical basis. As a matter of fact, the technicians will have precious little to say about wide film standards;—this matter will be settled by the business leaders of the industry.

Any discussion of wide film inevitably leads around to the question "Is wide film necessary; is it desirable?" It may not be absolutely necessary to the survival of the motion picture business, but to our way of thinking it certainly is desirable. It has been our pleasure to see several wide film presentations, and we thoroughly enjoyed all of them. Inevitably these performances disclosed certain defects in production and reproduction technique, but once the project is launched we may expect the technical men to iron out the wrinkles. And when this task is finished we may expect to see motion pictures of compelling interest, with a brand new flavor with which to beguile the showgoer. Wide film should be simply great.

As for standardization, there is nothing to do but await the verdict of those who guide the destiny of this industry of ours. When they are ready to "shoot," the rest of the industry will fall into line.

¶ *Achievement*

WITH more than 10,000 theatres in the United States alone wired for sound pictures, the job of converting the general public to a new form of entertainment is practically finished. The best indication that this is so is to be found in the fact that already certain amusement leaders feel impelled to stimulate the public interest a bit by promising them new wonders in the theatre —television. Television has often been the topic of discussion in this section, and it is unnecessary to amplify our former statements on this art.

But to return to sound pictures: what a grand job has been made of it. Of course, the industry was practically supervised by the so-called "electrics" for a period of more than three years, but in view of the good job done by the latter there can be no legitimate complaint on that score. In retrospect, the change to sound pictures in such a short time and with so little difficulty is a wonderful tribute to the men who directed both the electrics and the picture business. The real story of the union of these two great industries still remains to be written. Here's hoping somebody who is competent will work up enough enthusiasm for the task in the near future. It will make absorbing reading.

¶ *A Nucleus for Organization*

WE print elsewhere in this issue an appeal by Sidney Burton in behalf of increased interest on the part of projectionists in the Projection Advisory Council. As we have repeatedly pointed out, the work of the Council will be of importance only to the extent of the cooperation accorded it by the rank and file of projectionists. The Council is the first organization to be formed for the exclusive benefit of the projectionist, the *only* organization for the general welfare of projectionists. Other branches of the industry are represented by one or more organizations. Only the projectionist is left out in the cold.

Mr. Burton is eminently qualified to voice the projectionist's viewpoint of general conditions within the industry. As President of the American Projection Society and Vice President of the Council, he is responsible in large measure for many recent advances made by the craft. Particularly is this true on the West Coast, where Burton has done splendid work in bettering projection. Other officers of the Council are men of high standing in the craft: President Barrows, McCullough, Welman, Greene, Rubin, Eckerson, Gray, Roberts, Dentelbeck, Eichhorn, Sutton, Isaac, Ricks, O'Brien—to name only a few. These men are the cream of the profession, all of them willing to contribute to the general welfare.

What an opportunity for the craft! Give these men the opportunity to demonstrate just how much they can do for all of us. Give them the support their past work and present enthusiasm for the Council entitles them to. Let them have the means to put their shoulders to the wheel for the craft and contribute that vital spark which will fire the enthusiasm of the entire craft for better work. Let them speak for you when you need a spokesman—in a pinch. Join the Council!

Some Aspects of National Electric Code

By JAC. R. MANHEIMER

E-J Electric Installation Company

RECENT fires both in the East and in the West have more than ever attracted the attention of the various fire underwriters and fire prevention bureaus to the necessity of formulating rigid and definite requirements in connection with the vast amount of electrical work now being installed or contemplated in the studios, laboratories, film exchanges, and theatres.

The writer hopes, through this paper,[1] to provoke sufficient discussion at this meeting to disclose any technical data regarding explosiveness of gases given off by film, especially in view of the statements made by some writers that nitrocellulose film is not explosive. It is not the purpose of this paper to discuss the chemistry of film nor the fire hazards attendant to the handling of it, but it cannot help but bring forth features which are relevant and important to some features of electric work, which have heretofore been uncertain.

The object of the Electric Code as recommended by the National Fire Protection Association is to provide definite requirements for the installation and subsequent safe operation of electric circuits, conduit systems, distribution centers, and electrical equipment in general in various types of buildings. The development, however, of the motion picture art has been so rapid, especially the electrical phase, that the Code has been unable to keep pace with it. This is partly due to the fact that the Electrical Code Committee revises the Code only every second year.

Existing Conflicts

The majority of our membership is generally familiar with many of the requirements of the National Electric Code applying to the motion picture industry; but few realize that if some requirements contained in the present Code were enforced, the development and expansion of the art would suffer considerably. Several items are ambiguously covered by the Code or are in conflict with it. For example, Section 503*n* reads, "Wires of different systems shall not occupy the same conduit." This is explained by a fine print note which states, "Different systems are those which derive their supply from (1) different sources of current; (2) transformers connected to separate primary circuits; or (3) transformers having different secondary voltages." While the ruling speaks of conduit only, it is interpreted to mean metal enclosures of all kinds, such as cutout boxes, raceways, troughs, and ducts.

In many systems of sound recording and reproduction, the a.c. street service is supplied to the motors which drive d.c. generators on motor generator sets. The generators usually furnish 12 volts for filament supply, 250 volts for grid bias, and as high as 1000 volts for plate potential. The circuits supplying these various voltages are grouped at the amplifying boards and in the amplifying tubes themselves.

There are also systems where different voltages are supplied from batteries which are in turn charged by either motor generators or rectifiers. The question at once arises as to whether, under the Section 503*n*, these wires can be installed in the same conduits.

The Recording Situation

The question of Code requirements is probably more complex in the studio at this time than in any other division of the industry. Section 503*q* of the Code limits the number of wires in a conduit or a duct to those given in a schedule under this section. This causes mechanical conflict at amplifying boards, horns, motor patch panels, and at other pieces of apparatus where thousands of wires from all parts of the building may terminate at one location.

For example, in the Western Electric Company's electrical interlocking recording system, the energy which operates the various synchronous devices is obtained from a special motor generator assembly known as a "distributor." The generator of this device functions as a phase changer since it has impressed upon it the house supply of 220 volts, 3-phase, 60 cycle current, and in operation the phases are shifted so that the output voltage is approximately the same as the input at 3-phase, but about 30 degrees phase difference. The distorted output supplies fractional horsepower motors on the various cameras and recording equipment in the studio at approximately 220 volts, 3-phase. The motor driving this phase changer is energized from a 110 volt d.c. supply which is the output of a 1½ kw. motor generator set. The motor on the 1½ kw. motor generator set is supplied by the 3-phase, 220 volt house current. The armature winding of the distributor motor is tapped at two opposite points through slip rings. By this means, 20 cycle a.c. at approximately 27 volts, is delivered for special speed control. This 20 cycle a.c. is passed through a small transformer and then through a rectifier tube for furnishing rectified plate current (d.c.) back into a special control field on the same motor for regulating its speed.

The same rectified a.c. is also transmitted to various "starting stations" on the studio stages to give visual indications on d.c. milliammeters of the amount of current in milliamperes flowing in the control field stated above. A d.c. series field is also provided on the driving motor of the distributor to give extra torque for "starting duty" only, but is automatically taken out of circuit when the motor reaches full speed.

The rotor of the distributor motor is equipped with a small inductor generator which delivers a.c. at a frequency of approximately 720 cycles and 130 volts and supplies energy through a filter which in combination with a rectifier tube furnishes the energizing current to the control field stated above.*

The camera and recording motors each have a rotor and stator with independent windings. The stators are supplied from the 3-phase, 220 volt house current and the rotors from the distorted phase supply output of the distributor. The rotor current has the same voltage and characteristics as the house current except for its angular phase displacement effected by the distributor.

From the distributor, a set of six wires is run to an interconnection panel, known in recording parlance as a patch panel. In addition to these six wires, there are two more wires for the rectified milliammeter current following the same route. Six wires are run between the patch panels and each fractional horsepower motor; eleven additional wires between the patch panel and each starting station.

Six wires running to the fractional horsepower motors are all a.c.

Two wires connect to the indicating d.c. milliammeters (rectified a.c.).

Three wires connect to a special 3-phase, 220 volt rheostat located at the motor station.

Six wires run to starting stations and are used for actuating solenoids, starting relays, and

(*Continued on page* 37)

[1] Read before S.M.P.E. at Washington meeting.

* In the theater projection booth, similar combinations having different voltages and different characteristics obtain with the Western Electric driving motor unit and speed control on projectors so that we have nearly the same problems, as far as the Code requirements are concerned, although of a lesser magnitude.

An Advertisement Every Serious Projectionist Should Read With Care



By
THOMAS J. BENSON

TELEVISION is just around the corner.

Without question Television is one of the greatest achievements of the human mind; it is also one of the greatest forces for human progress. Like the great inventions that preceded it—the telegraph, the telephone, and radio—it will annihilate space, and make it as inconsequential as a city block.

Ten years ago Television was a faint glimmer which our scientific men discerned in a shadowy world of possibilities. The application of their genius and industry has today made television a fact. People already are able to see each other, although thirty miles apart. The further refinement of the instruments already developed will shortly make the thirty into three thousand, then thirty thousand miles until we, in New York, will be able to see instantaneously others at the extreme farther side of the world.

Industry, of course, will turn Television to its manifold uses at once, as it has done with all inventions. Can it be used for recreational, for entertainment purposes also?

Of course it can—and it will! The great business and industrial institutions of this and other countries that are now backing the development of Television will immediately apply it to the theatre. Millions of homes will be equipped with Television receiving sets, as they now are with radio, and the motion picture theatre will harness it for its own use.

Right now there is a great deal of speculation concerning the nature of the kinship between Television and the motion picture theatre. Some say that it may do away with the theatre—that everything the theatre offers today, music, photoplays, dancing, chorus girls, singing opera stars, musical comedies,—will come straight into the home by means of radio, and Television. Others declare that it will do away with photoplay production—that the story will be acted out before the Televisor and broadcast immediately into the homes and motion picture theatres. Still others—and there are eminent authorities of the theatre and scientific world among these—state that nothing will be changed, that Television will simply help the theatre to further amuse its patrons, just as *sound* pictures have done. It will not hurt the theatre, but help it.

There is no doubt whatsoever that the motion picture theatre will continue to exist—and will turn Television to its own uses. Roxy, master showman of all time, has declared publicly that he is waiting impatiently for the perfection of Television, that he will at once harness it to his showmanship genius and apply it in the Roxy Theatre. Other magnates are even today making provision for Television equipment in their new movie hippodromes.

There has been talk already of the exact application of Television to the theatres. Dr. Lee De Forest, a man of science and of vision, thinks that Television will become a monopoly of the telephone companies; that these will supply and install the necessary equipment for public and private uses, as they now do the telephone instrument; that they will supply entertainment via Television, the same way they now make telephone connections, that is, by request of the renter of the equipment, and will charge them accordingly. Dr. De Forest has even declared that these charges will be added to renter's monthly telephone bill. The theatre will make use of it this way.

Perhaps this is the way it will be done. Why not?

Another question concerns the nature of the equipment which theatres will use for Television. That question cannot be answered now. It may become part of the equipment now in use in the motion picture theatre projection room; it may be necessary to place it on the stage and project on the screen from the rear—it may be one or both of these processes. But this is certain—theatres will need new equipment for Television *and smart men to operate it.*

Boone Maneall

Order a copy of TELEVISION today—price $3.50. SOUND PROJECTION ($6.00).

The price is $8.00 for the two books. Order from the MOTION PICTURE PROJECTIONIST, 45 W. 45th St., N. Y. C.

Review

MANY recent requests for information on the fundamentals of the sound projection art indicate that new subscribers and subscribers of long standing who have not now the earlier issues of this publication in which the basic groundwork of the art was covered, now require similar information with which to intelligently pursue their work. The following communication from T. L. Dowey of ERPI is illuminating in pointing the way for this publication to render a service to its readers, both new and old, in inaugurating a review department in which from time to time information bearing on the fundamentals of the art may be presented:

". . . All the things this man asks for have been very fully explained in MOTION PICTURE PROJECTIONIST in the past, but it is quite true that there has not been very much on elementary facts of vacuum tube action in the past year or so—you have naturally assumed a certain amount of such knowledge on the part of your readers and have gone on to more advanced matters. This man's interest in the subject has probably been aroused comparatively recently, and he is unaware of your earlier articles or did not notice them at the time they were published. It seems to me that a reprint of some of the elementary articles you were publishing 18 months or 2 years ago would prove quite valuable to this man and probably to many others like him—that is, men who have only recently begun to take a serious personal interest in amplification theory. I am enclosing a particular article which originally appeared in the *Movietone Bulletin* which does not require any changes or modifications and which should serve the purpose very well indeed.""

Thanks are due and are hereby tendered to Mr. Dowey for this suggestion; and the Review Department is launched with the appended discussion of amplifiers. Subsequent issues will contain data on other fundamentals of the art.—*Editor.*

Vacuum Tube Amplification

While various other means have been tried at different times in the past, practically all amplification required nowadays in radio, in telephony, and in voice and music reproduction by such means as the Movietone, is accomplished by the vacuum tube. Supposing we consider two metal terminals (or as they are called in vacuum tube work, "electrodes") which are connected by wires to the poles of a battery or other source of current. As is well known, if these two terminals are held, say, an inch apart in the air, no current will pass, unless, of course, the voltage happens to be so great that the air insulation is broken down and a flash takes place.

If we go a step further and enclose the two electrodes in a glass bulb, from which the air has been exhausted, bringing the connecting wires through seals, just as is done in an ordinary electric lamp, the same will hold true—we will have no current except with very high voltages. However, if we find some means of making one of the electrodes red hot, and if this electrode is connected to the negative pole of the battery and the other electrode to the positive pole, it will be found that a small current passes. This is called the "Edison Effect" from its having been discovered by Edison about forty years ago in the course of his early researches on the development of the incandescent lamp.

The Edison Effect

The hot electrode in this case was the carbon filament of the lamp. This phenomenon remained unexplained and unutilized until the early years of this century, when the progress of physics made it clear that the passage of current with the hot filament was due to the fact that the latter emits electrons, which we can best think of as particles of negative electricity.

Electrons fly off in all directions from a hot electrode enclosed in a vacuum tube, but if the tube contains a second electrode to which a positive voltage is applied, most of the electrons being negative, will be attracted to the latter and will flow towards it in a steady stream. As an electric current is nothing but a stream of electrons, a flow of current between the two electrodes will be the result.

The fact that the electrons are attracted to the positive electrode gives the clue to the further step necessary before this device can be used as an amplifier. Since a positive electrode attracts the negative particles, it seems reasonable to suppose that a negative electrode will repel them, and that if this negative electrode is inserted between the hot filament and the positive electrode it can be used as a gate or barrier to intercept the electron stream and enable it to be controlled as desired. This is the way in which the vacuum tube is used as an amplifier at the present time.

Plate and the Grid

The positive electrode is what is known as "the plate," and consists in some tubes of a small square piece of nickel and in others of a small cylinder of nickel. The barrier or gate to which the negative voltage is applied and which partly cuts off the electron stream is termed "the grid," and consists of a small ladder-like structure of nickel wire interposed between the filament and the plate, or a spiral in the case of tubes with cylindrical plates.

Suppose now that it is desired to amplify a feeble alternating current representing voice or music pick-up. This current is applied to the grid and causes the negative voltage on the latter to fluctuate according as the alternating voltage aids it or opposes it. Consequently, the stream of electrons, and therefore the current through the plate, likewise fluctuates. If the tube is properly designed and operated, the fluctuations occurring in the plate current will be an exact copy of the alternating current applied to the grid, except that they will be very much more powerful.

It is very essential to the correct functioning of a vacuum tube that the negative voltage applied to the grid should be of the proper value. The filament used as a hot electrode in modern vacuum tubes is a platinum strip with a special oxide coating, which is chosen because of its ability to throw off large quantities of electrons when heated. As it is not practicable to get all the amplification required in Movietone from a single vacuum tube, several are employed to increase the power by steps, the plate output from one going to the grid of the next, through suitable circuit connections.

A, B and C Batteries

The custom has arisen of designating the battery supplying the heating current for the filament as the "A" battery, while the battery supplying the plate voltage is known as the "B" battery and the battery supplying the negative voltage for the grid is termed the "C" battery. Depending on the type and size of the equipment, some of the amplifiers used with Movietone employ storage "A" and "B" batteries and dry "C" batteries; other amplifiers are employed in which rectified alternating current furnishes all three types of supply; and in still other cases the supply is partly from batteries and partly from rectified AC.

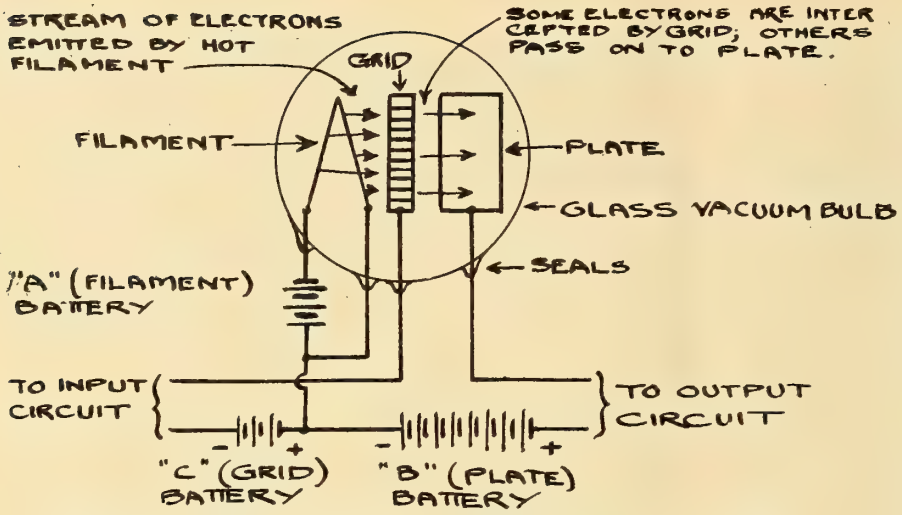
The operating instruction book which is supplied to each theatre describes in detail the types of amplifiers used on that particular job and the method of current supply.

Having got a clear picture of some of the fundamentals of an amplifier we are now in a position to intelligently consider how to take care of it and deal with such troubles as may arise.

Care of Tubes

Tubes are seldom a source of difficulty. Their life will, of course, depend very largely on the extent to which the equipment is used daily. The life of a vacuum tube is seriously reduced if the filament current is too high; the reason for this is that an overheated filament throws off electrons at an excessive rate and the oxide coating, which supplies most of the electrons, therefore becomes rapidly exhausted.

When a filament is near the end of its life, a weak spot usually develops which glows more brightly than the remainder. Whenever a tube begins to show this symptom it should be replaced by a fresh tube



ELEMENTS OF VACUUM TUBE

from the spare stock. If the filament current is too low the tube will not be harmed, but the system will not deliver proper volume and the quality may be impaired. Therefore, always regulate the filament current carefully to the value specified in the operating instructions.

Noisy tubes are occasionally encountered; this is due to irregularities in the rate of emission of electrons by the filament. Such tubes will rarely give trouble unless they are in the first stage of the amplifier, where the high sensitivity makes a quiet tube essential. If noises are heard from the horns with the fader at zero, there may be reason to suspect a noisy tube, and the first stage tube of the first amplifier should be interchanged with one of the other tubes, or with a spare, to see if this clears up the condition.

Storage Batteries

With amplifiers deriving any of their power supply from storage batteries, it is a very important matter to always keep the batteries in first-class condition. Loose connections, or accumulations of acid or dirt on top of the battery, are capable of causing fluctuations in the current which it delivers to the amplifier. These fluctuations are amplified and reproduced by the loud speakers, in just the same way as the fluctuations repeating speech or music picked up from the reproducer, and are responsible for disagreeable frying and crackling sounds. Battery noise may also occur if the batteries are used soon after charging, while they are still gassing.

Proper Voltage Level

As has been mentioned previously, it is very important for the proper operation of the amplifier that the "C" voltage which keeps the grid negative should be maintained at the correct value. In the case of amplifiers where this voltage is furnished by small pocket flashlight dry batteries inserted in battery boxes on the front of the amplifier, periodic inspection is desirable to insure that the voltage is not below a satisfactory value. Once a month is sufficient. On the front of the battery box will be found a set of small metal contact studs where connection may be made to a low reading voltmeter.

The operating instructions furnished with each installation give the proper voltages which should be found between each pair of these contact studs on each type of amplifier. The voltmeter should be kept on the battery as short a time as possible, as it draws current and naturally contributes something towards the eventual exhaustion of the battery.

Plate currents in excess of the values specified in the operating instructions are an indication that the grid voltage is insufficient. If the "C" batteries are in good condition, this may be due to their making poor connection with the grid circuit. It may be remedied by cleaning with fine sandpaper or emery cloth, or scraping lightly with a knife, the battery springs and the contact springs at the bottom of the battery box; it may also be desirable to bend the battery springs a little to get firmer contact pressure.

There may also be failure to make proper contact at the pin terminals in the base of the vacuum tube, resulting in failure of grid voltage as just described, or an absence of plate or filament current. In such cases, do not use sandpaper, emery cloth, or scraping on the tube terminals, but clean them off with rubber eraser. Otherwise they may become pitted and ultimately make worse contact than before.

Rectification

Where part of the amplifier power supply is derived from rectified AC it is, of course, essential that the rectifier itself should be in perfect condition. The same remarks made about the care of amplifier tubes apply to rectifier tubes; the filament current should be carefully regulated to the value specified in the operating instructions and when tubes begin to show signs of deterioration they should be replaced.

It may be mentioned that when a vacuum tube is used as a rectifier, advantage is taken of the fact that although as already mentioned current can pass from the plate to the filament, it does not pass readily in the opposite direction. Therefore, if one terminal of an alternating current circuit is applied to the filament and the other to the plate, current will get through only in the one direction. The grid plays no active part in this process, of course. Two tubes are employed in each rectifier associated with the amplifiers in Movietone installations; this allows of using both halves of the AC wave.

In the case of the Movietone amplifier, which forms part of the attachment of the projector, it is very important to see that the spring suspended cradle on which the tubes are mounted is swinging clear of any obstruction, and that no part of the photo-electric cell is directly touching the frame of the attachment, as otherwise machine vibrations may be picked up by the tubes and heard in the horns.

The amount of amplification produced in an installation is controlled by means of a dial switch on the first amplifier of the set on the rack. This dial switch will be set by the ERPI engineers at the point required for satisfactory operation and should not be changed unless specifically directed by them.

The extinguishing of a tube usually indicates that the filament has broken and that its life is ended. In some cases two or more tubes are operated with their filaments in series; then if one of the tubes burns out the others will also be extinguished. Inspection is needed to determine which is the faulty tube. Cases of this sort are covered in detail in the operating instructions furnished with each installation.

Amplifier troubles outside of those which have been mentioned are quite rare and if the remedies which have been mentioned fail to bring an improvement and you conclude that you have a case of this type on your hands, bring the matter immediately to the attention of the ERPI service engineer, who takes care of your theatre.

Audiphones Prove Popular

Western Electric Audiphones for the hard-of-hearing are winning new friends for about 100 theatres that have installed this equipment and are now definitely catering to the patronage of those suffering from defective hearing.

The Fox Theatre in St. Louis has started a scrap book of testimonial letters received from patrons who were able to enjoy talking pictures as a result of installations in that theatre.

The Adelphi Theatre widely advertised its installation as "the first in Chicago." It ran a bulletin board on which letters of appreciation from patrons were posted and favorable newspaper comments were pinned. The latter included Rob Reel's section in the Chicago Daily American reviewing "The Big House," with a two column head: "Adelphi Thanked by Deaf." Rob Reel thought the audiphones were so important that he reprinted extracts from some of the letters received by the theatre and referred to the invention as "Another star for Old Man Movie as the World's greatest entertainment."

Electrical Research Products reports a steady demand for these audiphones.

in the Laboratory

Conducted by SAMUEL WEIN

A Comeback for Selenium?

WE are reliably informed that Warner Brothers Co. has acquired recently a license to use the Russel Hart patents in sound recording and reproduction. Our concern here is chiefly with the adaptation of the selenium cell as the light sensitive medium, one of several patents issued to Mr. Hart. It will be recalled that in our previous writings the selenium cell was shown to have two outstanding characteristics in its favor:—(1) that little amplification is required, and (2) its use entails no "patent situation."

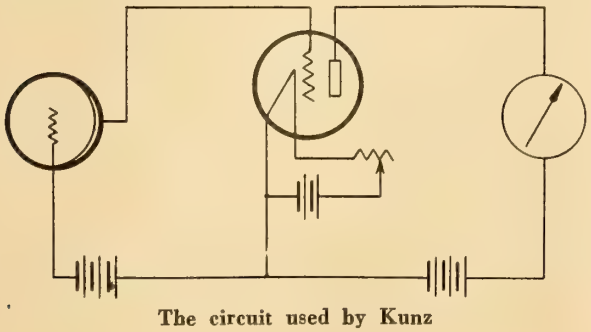
For a number of years prior to the development of the present photo-electric cell the selenium cell had no serious rival as a superior light sensitive medium. The modern photo-electric cell replaced the selenium cell primarily because of the "inertia" possessed by the latter. This problem has had the attention of many workers in the art who have studied the effect of light on annealed selenium, but thus far no one has succeeded in making a contribution which would overcome this handicap.

Selenium Cell Sluggishness

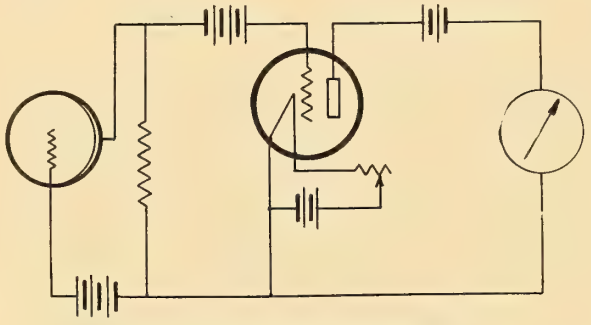
The word "inertia" in this case is meant to indicate the sluggishness displayed by selenium cell in a return of its resistance after it has been exposed to light. A selenium cell will respond instantaneously to light, but it is comparatively slow in returning to its normal resistance value. The effect noted is a "creeping" one, and, in fact, it has been noted that it requires several seconds—and sometimes, hours—before the cell returns to its normal resistance.

All the early workers in the art of sound recording and reproduction used the selenium cell with satisfactory results, despite its inertia characteristic, but it is quite true that the inertia period will prevent the higher sound frequencies from being reproduced from the film.

Many investigators have studied the effects of various "addition" agents to selenium, with a view, of course, to changing its general characteristics so that the inertia period might be eliminated. Mr. Hart, it is reported, has increased the sensitivity of the cell to the infra-red end of the spectrum, and has also increased its sensitivity with respect to frequency response. This has been accomplished by adding a trace of metallic iodine to the selenium and thereafter annealing same. The writer had occasion some ten or more years ago to use the Hart selenium cells and these he found to be extremely sensitive to both light and temperature. Extreme care had to be exercised, however, in adjusting the proper potential, otherwise the cell would be rendered unfit for use.



The circuit used by Kunz



Showing the Langmuir hook-up

There seems to be some technical error in the manufacturing procedure of the Hart cell according to information gleaned from the Hart patent. It will be remembered that selenium is annealed at temperatures ranging between 170 and 200 degrees C. Iodine melts at 114° C, and boils at 184°. In view of these facts, then, my contention is this:—When the annealing process is finished the iodine is no longer a part of the selenium. No reaction product has been formed between the selenium and the iodine, since the iodine will have volatilized long before the proper temperature for annealing the selenium has been reached.

A later patent of Mr. Hart discloses how to treat the completed selenium cell with a saturated solution of iodine in alcohol. Organic compounds containing iodine were also tried and satisfactory results were obtained as a result thereof.

Samuel Bagno has recently conducted some interesting experiments with forming selenium cells with traces of iodine, although his procedure differed from that of Mr. Hart. Mr. Bagno annealed the selenium in Mazola Oil, which contains iodine, resulting in a better manufacturing procedure. Tests made with the Bagno cell show it to be ideally adaptable for sound motion picture work, since its curve indicates a response of considerably more than 8,000 cycles.

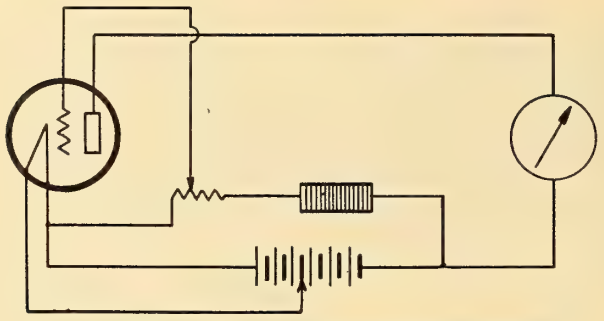
Apart from the different manufacturing procedures, it might be well to bear in mind the thought that selenium has not yet been counted out for sound picture work and there is every possibility of it staging a comeback under actual test and observation in studio and theatre work.

References:
U. S. Patent No. 1,491,040.
U. S. Patent No. 1,730,505.

Light Sensitive Cell Amplifiers

NOW that a decision has been rendered on one phase of the development in recording and reproducing sound on motion picture film (we refer here to the use of the "slit"), we are advised that certain interests are now planning to bring suit to sustain their rights on the use of an amplifier circuit prior to its entrance into the power amplifiers. Like the "slit" situation there is available very interesting literature on this amplifier circuit phase of the art which is worthy of consideration.

A great many technicians are inclined to credit Professor Kunz[1] with being the first to adapt the photo-electric cell into a three-element vacuum tube circuit as a



The Von Lieben, Strauss and Reisz contribution

means for amplifying the minute photo-electric potentials generated as a result of light falling thereon. The circuit as used by Professor Kunz is shown herein. Of importance is the fact that the grid leak was omitted by Prof. Kunz, and, as everyone will agree, its commercial adaptation to the arts is seriously questioned.

Dr. Langmuir[2] in his disclosures shows a more modern circuit which was described by him prior to the work of Prof. Kunz (compare filing dates of Langmuir:—February 5, 1914, and October 29, 1913).

The first to adapt a three-element vacuum tube with a "light sensitive cell" were Von Lieben, Strauss, and Reisz[3]. These men used the selenium cell as a "floating grid" with a potential across it. It is apparent from a study of the contributions of these men that the subsequent work of Kunz and Langmuir was merely a modification of this original contribution. Another modification of the Von Lieben, Strauss and Reisz contribution may be found in the circuit employed by Professor Compton[4] in photometry (light measurement) work.

Those sufficiently interested will also find considerable interesting data in the contributions of Nicholson[5], and Nakken[6].

References:
[1] Phys. Rev. (2), Vol. 10, p. 205, 1917.
Phys. Rev. (2), Vol. 13, p. 102, 1919.
[2] U. S. Pat. No. 1,273,627, July 23, 1918.
U. S. Pat. No. 1,282,439, Oct. 22, 1918.
U. S. Pat. No. 1,313,094, Aug. 12, 1919.
[3] Electrotech. Zeit. Vol. 48, p. 1359, 1913.
[4] Trans. Illum. Eng. Soc., Vol. 15, p. 28, 1920.
[5] U. S. Pat. No. 1,470,696, Oct. 16, 1923.
[6] U. S. Pat. No. 1,522,070, Jan. 6, 1925.
Reissue Pat. No. 16,870, Feb. 7, 1929.

The Trend of New Developments

THAT sound motion picture systems are now passing through a process of refinement is evidenced by the fact that much of the apparatus has been greatly improved with respect to increased sensitivity and a greater output, depending, of course, on the particular device under consideration. At present there are several concerns offering for sale photo-electric cells of a different kind. These cells consist of a film of silver on copper which is oxidized and after which caesium is distilled on the oxidized plate. Two types are manufactured: the hard-vacuum and the gas-filled types. These cells are considerably more sensitive to the red end of the spectrum and the output in microamps per lumen is greater than that now obtained with the common alkali-metal hydride cells.

In England still another type of photo-electric cell is being exploited. This consists of an alkali-metal oxide deposited on the inner walls of a glass bulb, or on a metal plate, and a filament. This type of cell gives rise to a greater photo-electric emission than any of the p.e. cells now available; in fact, several hundred times the output.

Selenium in Practical Theatre Work

It may be news to a majority of workers in the art that the photo-voltaic (liquid), cell is now being used in quite a few of the smaller theatres, where experiments have shown this type cell to give very gratifying results. The advantage to be had from using this cell lies in the fact that no batteries are required to make it function. All that needs to be done is to couple the cell direct to a low impedance primary winding, the secondary winding of which is of a high ratio, and this in turn is connected into the grid of the first stage of the amplifier at a remote place. No "head" amplifiers are required with this type of cell, and no hissing or other noises that are prevalent with photo-electric cells are apparent.

Other light sensitive cell developments are taking place in the field of selenium, a discussion of which appears elsewhere in this section. A new type of light sensitive cell will soon appear on the market, preliminary announcements of which indicate that it will combine all the features of the photo-electric and other types of cells. Definite facts on this development are lacking at present.

Some of the late developments in light sensitive cells will undoubtedly necessitate proper amplifier circuits, accordingly it is well that the projectionist keep abreast of the activity in this field and acquaint himself with the characteristics of cells and the various circuits with which they are incorporated.

The Photo-Electric Effect

NOBODY knows why the current varies with the amount of light that enters the photo-electric cell. All anybody knows is *how*. It has been discovered that when light falls on certain metals electrons are given off, just as electrons are given off metals when they are heated. It has also been found that when the metals are put in a vacuum the number of electrons emitted by a given metal with a given amount of light is greater. Also, it has been found that certain metals emit electrons more readily than others.

For example, the alkali metals—sodium, potassium, and caesium—emit electrons copiously, and for that reason these and related metals are used in photo-electric cells. The photo-electrically active metals are deposited in a thin layer over the inside wall of the glass envelope of the cell and the light is admitted through a hole in this layer. Another metal electrode is placed in the center of the tube and a high voltage is impressed between the central electrode and the thin metal layer, with the positive terminal on the central electrode.

For a given voltage between the electrodes the number of electrons is, within certain limits, directly proportional to the amount of light energy that enters the cell. It is this proportionality that makes the cell particularly useful where freedom from distortion is essential. Another of its valuable properties is that the changes in the current through the cell vary instantaneously with changes in the amount of light.

Use of "Shield Grid" Amplifiers

UNTIL very recently but little work had been done with the "shield grid" tube (four element), for audio frequency amplification, although it is well known that this type of tube does the work of two or three ordinary tubes in radio frequency amplification. The use of a shield grid tube gives rise to a greater voltage amplification per single tube than does any other commonly known type tube.

By coupling the photo voltaic cell with a low impedance transformer (primary), the secondary of which is connected directly to the control grid of the tube, and thereafter using the conventional resistance-coupled amplifier, using shield grid tubes, they have succeeded in building a very efficient unit which gives rare tonal qualities. We are advised also that the RCA Photophone, Inc., has recently built a more efficient sound picture amplifier which employs shield grid tubes.

The advantages of shield grid tubes are: (1) the reduction of noises due to interstage coupling, (2) facilitate the use of A. C. operation throughout, avoiding the use of cumbersome batteries and their attendant care, and (3) amplifiers built with shield grid tubes require but very little space, as compared with other type amplifiers.

The Terminology of Photometry[1]

THE total amount of light emitted is commonly called the flux of light. Since light travels in straight lines, it is evident that a small area near the source of the light will receive as much light as a larger one at a distance (Figure 1). The small area will thus appear more brilliantly illuminated.

The brilliancy of a light source is a measure of the flux of light emitted. The intensity of light, or flux of light, in any specified direction is measured in candles. A candle is the luminous intensity of light emitted by a standard candle. This is a candle made according to certain definite specifications and burned under specific conditions. It is an arbitrary unit for measuring luminous intensity.

Since practically every artificial light source emits different quantities of light in different directions, the brilliancy in only one direction can be used as the unit of comparison. The light giving power in the horizontal direction has been made the basis of intensity measurements. By horizontal direction is meant every direction in a plane perpendicular to the axis of the light at its center.

Candle Power

The candle power of a lamp is its luminous intensity expressed in candles. The candle power of a lamp is usually different in different directions, hence the average or mean of the intensities is usually given. The average or mean candle power may be the average of the intensities in a great many different directions. The mean spherical candle power of a lamp is the average of its candle power in all directions. The usual luminous rating of lamps is expressed in mean horizontal candle power; that is the average of all values of luminous intensity in the horizontal plane.

It is evident from figure 1 that the amount of light from a point source falling on a given surface decreases as the square of the distance of the surface from the source of light. The amount of light that is incident upon a square foot at a distance of one foot from the source is spread out over four square feet at a distance of two feet.

Evidently the illumination produced will vary with the quantity of light falling on the surface. That is, the illumination also varies inversely as the square of the distance of the illuminated surface from the light source.

The Foot-Candle Unit

A standard candle will produce a certain definite illumination on a surface at a distance of one foot. This illumination is called a foot-candle. It is a unit of illumination and not of candle power. In Figure 1, if "S" is a lamp of 1 CP intensity, and "A" is a surface one foot away, the intensity of illumination is one foot-candle. If the surface is further away, like "B" for example, the intensity of illumination is less or ¼ of a foot-candle. The foot-candle is a unit of intensity and accordingly any value expressed in foot-candles must be a value of one point only, unless it is given as an average value.

The quantity of light emitted by a light source has been called the flux of light. The amount of light that produces an average illumination of one foot-candle on an area of one square foot is called a lumen. What is meant by a quantity of light will be better understood by references to Figure 1. The solid angle included by the planes aSb, bSc, cSd, and aSd, may be considered as including a certain amount of light.

The luminous intensity in candle power may be different in different directions within the solid angle, but the quantity of light within the angle is a definite fixed amount. If this amount is such that the illumination on "A" per square foot is one foot-candle, the light flux in lumens is equal to the area of "A" in square feet. If "A" has an area of one square foot and the average illumination is one foot-candle the quantity or flux of light is one lumen. If we assume "S" to be a point source emitting light uniformly in all directions, then the total flux in lumens is equal to 4π times candle power of "S."

Assume for the above condition that the point source is at the center of a hollow sphere whose radius is one foot. Then the total light flux emitted by the point source is intercepted by the internal area of the sphere, hence the total flux in lumens will be equal to the area of the sphere multiplied by the intensity of the point source.

Abbreviations of the above terms follow:

Candle Power—C. P.
Mean Horizontal Candle Power—M. H. C.
Mean Spherical Candle Power—S. C. P.
Foot Candle—Ft. C.
Lumen—L.

[1] Contributed by Photo-Electric Division, Arcturus Radio Tube Co.

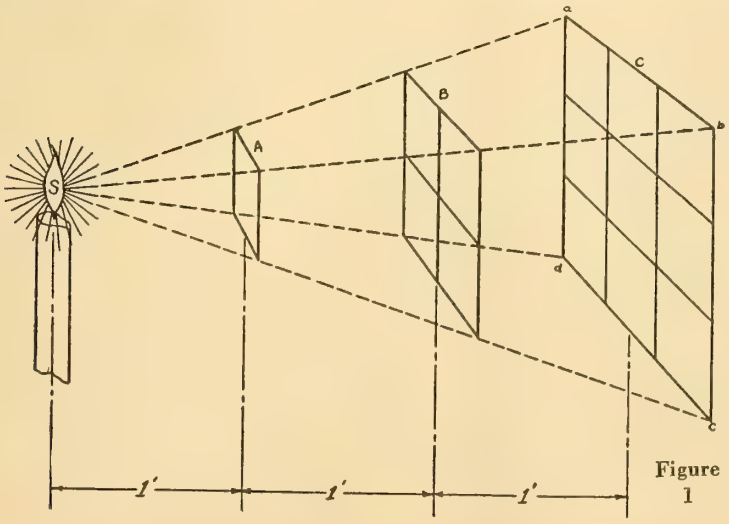


Figure 1

Electrolytic Condenser Action

By JOSEPH CALCATERRA[1]

IF an alternating current is applied across a cell consisting of an aluminum electrode in certain electrolytes, current will flow through the cell when the electrolyte is positive with respect to the aluminum electrode. No current, however will flow when the current reverses so that the aluminum is positive with respect to the electrolyte, provided a certain critical voltage is not exceeded.

This rectifier action is caused by the formation of a very thin film on the aluminum electrode. The film has the peculiar property of offering very little resistance to the flow of current from the electrolyte to the aluminum electrode, but of offering very high resistance to the flow of current in the opposite direction, from the aluminum to the electrolyte.

For all practical purposes, the film may be considered as a very thin dielectric between the two conducting electrodes (aluminum and the electrolyte), as far as currents which would tend to flow from the aluminum anode to the electrolyte (aluminum positive with respect to the electrolyte) are concerned.

Higher Capacity Obtainable

Since the dielectric film is very thin, and the film is formed on all surfaces of the aluminum electrode, the capacity obtainable per square inch of the aluminum electrode is very high, especially when sheet aluminum is used as the positive electrode, or anode of the condenser cell.

The great difference in the thickness of this dielectric film, as against the much greater thickness of the waxed paper dielectric used in paper

[1] Aerovox Wireless Corp.

condensers, accounts for the much higher capacity obtainable in a given space in the electrolytic condenser.

Because of the polarized feature of all types of electrolytic condensers, they should be used only on steady or pulsating direct current or rectified alternating current circuits.

Proper Circuit Connection

In connecting the condenser into a circuit, the anode or positive terminal should always be connected to the positive side of the circuit and the cathode or negative (can), terminal should be connected to the negative side of the circuit.

The use of electrolytic condensers under conditions of voltage in excess of their rated peak voltages will result in failure of the condensers, the failure being temporary if the overvoltage is applied for a short time and permanent if continued for long periods. Failure of the condensers under such conditions is no reflection on the quality of the condenser since the application of such excessive voltages constitutes abuse of the condenser.

Measuring Peak Voltages

In measuring peak voltages in various circuits, measurements should be taken under actual operating and "no load" conditions and with primary voltages which may be met with in actual service, since the removal of tubes from their sockets, the initial time lag before tubes begin to draw current, line fluctuations and other such factors will cause peak voltages to rise beyond their normal values.

The measurements should of course be made with a peak voltmeter and not with a standard D. C. voltmeter. It is also very important to use accurate measuring instruments in making such tests. An error of 2% may mean a difference of 10 volts at 500 volts so that an inaccurate meter may read 495 to 500 volts when the actual voltage in the circuit is actually 505 to 510 volts, an excessive voltage for continuous operation.

Effect Slides Valuable Projection Aid

By HARRY RUBIN

Supervisor of Projection, Publix Theatres

WITH a great variety of effect slides available, projectionists are enabled to "dress up" their shows with a Brenograph or stereopticon presentation, obtaining economical yet very effective presentations which reflect credit on their work and mean extra money at the box-office. Publix has done much good work with effect slides, but similar ideas may be employed by all theatres with results equally effective. A little initiative on the part of the projectionist and cooperation with house managers on the "idea" will result in finer presentations.

Effect slides may be used in two ways. The slides are made up in positive and negative. One way to use the slides is to put both slides on together. The other way is to put either the negative or positive slide on, this giving one effect. Then by adding the other slide in the effect machine, another effect will be obtained. It is also possible, in using an effect slide, to get either a day effect or a night effect simply by employing different color gelatines.

Projection Procedure

When using effect slides never show a blank screen or close in on a blank screen. Fade effect slides on your front house curtain slowly and then when the curtains open, the effect is already there on the screen for the audience to see. When closing in, draw in the curtains and then fade the slide out slowly.

The procedure for effect slides is to project the effect on a magnascope screen a few seconds before beginning the film, to register an atmospheric impression on the audience. Then project the picture onto the effect. The effect is generally kept on the big screen until the main titles, credit titles and cast of the film is run off. At the end of the titles, the magnascope screen is drawn down to the standard size picture screen and the effect dissolved from the effect machine.

Effect slides of suitable design are particularly helpful when desiring to present short-length material, such as novelties, trailers, musical or singing numbers, etc. In this connection, it is necessary to block out the center of the slide to allow for the picture. It is also preferable to keep the effect slide on during the entire subject. In blocking out the slide, it is necessary that the picture fit perfectly into the blocked out portion of the slide, when both effect and picture appear on the screen. When this is properly done, you get an illusion of depth.

For Presentation Work

Effect slides are invaluable in organ recitals and presentations. Effect slides are projected on the full magnascope screen, using suitable designs and color combinations, and kept on the screen throughout the entire recital. Word or letter slides can be superimposed on the effect design with the regular stereopticon. This serves as a colorful background. By changing effects weekly you can always have an interesting variety to give your patrons.

Slide effects are also used to produce atmospheric effects on front curtains while musical overtures or prologues are presented. These front curtains, however, must be constructed of material that will take projection.

Color wheels can be used on designs adapted for them. Also in conjunction with the effect slides moving effects can be used, such as clouds or water ripple, etc., on designs suitable for them.

Schneider Machines to Museum

Motion picture history in America will be greatly enriched by the gift of thirty-three of the early machines used in the industry to the Smithsonian Institution at Washington under the will of Mrs. Stanislawa Schneider, widow of Eberhard Schneider, an inventor and manufacturer, filed for probate in Queens County, N. Y., recently.

Mrs. Schneider died in Flushing, Sept. 2, leaving an estate which, in addition to the collection, contains little more than personal and household effects and is not expected to exceed $2,500. Four daughters and two sons will share the residue.

Included among the machines is the first practical motion-picture projector, which Mr. Schneider brought out about 1891.

Disc Recording Efficiency

As illustrating the efficiency with which the wax negative is developed and printed, records are made available on an overnight basis in any quantity which the various studio needs require. In emergencies the records can be processed in three hours after being recorded. Additional records can be obtained on a few minutes' notice if required in a hurry. In this respect, the disc record keeps pace with the ordinary schedule of development of the picture film.

Good quality of reproduction is essential, and this quality must be consistently obtained for successful work. Disc records can be duplicated without limit as to number, and each record will be just the same as all others.

The disc record has, to a high degree, the very essential element of consistency; that is, the quality of recordings from day to day is not affected appreciably by the recording medium. The quality of reproduction can be intentionally varied over a wide range of electrical circuit changes, and thereby many defects arising from inefficient pick-up of sounds can be partly eliminated. While this is true of any method of recording, the consistent quality of disc recording makes easy such corrections.

Surface noise is usually determined by undesired sounds on the recording stages, chiefly camera noise. Where only the wanted sounds are recorded, the surface noise is largely negligible.

From the viewpoint of production efficiency, the disc record has the merit of being ready to go at all times.

New Equipment and Appliances

RCA Hard-of-Hearing Apparatus Now Ready

RCA Photophone, Inc., announces the perfection of the Acousticon Seatphone which is to be installed in theatres as an aid to the hard-of-hearing. The Acousticon Seatphone is the product of the Dictograph Products Company, manufacturers of the individual and church Acousticons and the engineers of that company, in collaboration with the engineering organization of RCA Photophone, Inc., have so co-ordinated the delicate sound reproducing equipment of each system that persons whose hearing is defective may now enjoy sound motion pictures equally as well as their neighbors whose hearing is normal.

The Acousticon Seatphone is an attractively designed device. A receiver is held to the ear by means of a lorgnette handle. A cord in the handle of the Seatphone extends for sufficient length to a plug which the user inserts in a receptacle on the arm of the seat. This receptacle provides the connection between the Acousticon Seatphone system and the amplifying system of the RCA Photophone sound reproducing equipment. Contact having been made, the Acousticon Seatphone at once picks up the sound to which those of normal hearing are listening and the hard-of-hearing patron proceeds to see and hear what is going on upon the screen with as much satisfaction as his neighbor. It might be said that he proceeds to enjoy what is seen and heard upon the screen with even greater satisfaction than his neighbor, for he is not being annoyed by conversation or other extraneous noises that oftentimes mar the presentation of sound pictures.

Volume Control

One of the important features of the Acousticon Seatphone is that the volume of sound can be controlled to suit the user. A tiny lever enables the hearer to reproduce 104 variations of sound, and adjustment may be made at any time.

It will be the purpose of RCA Photophone, Inc., to introduce the Acousticon Seatphone to every exhibitor of sound motion pictures in the country. Installed at Proctor's Fifty Eighth Street theatre, New York City, several months ago, the new device has been warmly received by hundreds of hard-of-hearing persons who previously had been denied the pleasure of enjoying the sound motion pictures presented at that theatre.

Line Voltage Fluctuations

"The line voltage problem is a serious one, and simply ignoring the issue is no solution," states John J. Mucher, President of the Clarostat Mfg. Co., of Brooklyn, N. Y. "We receive numerous complaints and requests for assistance. Peculiarly enough, the complaints regarding fluctuating line voltage are not confined to hydro-electric power areas, where such trouble is commonplace, but come from our largest metropolitan centers with steam power plants of ample generating capacity. Service men report line voltage variations from 90 to 140 volts, in some instances over 150. Obviously, tubes are not made to function satisfactorily with such variations from the standard 110-120 volt supply, hence tube failures, power-back breakdowns, and poor results are constantly reported by those out in the field.

"In view of the simplicity and low cost of providing line voltage regulation, it seems unbelievable that anyone can continue to permit such service troubles except that fluctuating line voltage is not generally understood nor appreciated. Furthermore, the power companies, by steadfastly insisting that their line voltages are scrupulously maintained—meaning at the powerhouse switchboard, of course, and not in the consumer's home where the power company has little or no control of conditions—we must continue to pay dearly for uncontrolled line voltage conditions."

A New Mellaphone Portable Disc Reproducer

A new portable disc reproducer is the latest product of the Mellaphone Corp., of Rochester, N. Y., well-known in the industry through the manufacture and distribution of other sound picture apparatus. All parts of this new portable equipment are cast aluminum, insuring lightness and true portability. The turntable disc, however, is a cast steel plate, insuring smooth quality reproduction of both music and voice.



Mellaphone Portable Reproducer

The Mellaphone portable employs special gears cut by the Gleason Works, and together with these gears is embodied an ingenious spring-suspended filter which tends to guarantee excellent tonal quality. Audak pick-ups are furnished with the equipment, and may be had in either high or low impedance and tuned models. A specially designed fader is also standard.

The portable motor drive is easily attached, no drilling or altering being necessary. It is not necessary to send a projector to the factory in order for the attachment to be made. This portable equipment is suitable for all types of projectors on the market. The complete turntable is furnished with a compact carrying case. Portable amplifiers and speakers are also supplied.

Sales of this Mellaphone portable equipment are through independent supply dealers everywhere.

The New X Cell

SINCE the advent of sound-on-film reproduction in the theatre there have been feverish attempts among scientists to bring the photo-electric cell to a state of perfection embodying high sensitivity, ruggedness of construction, uniformity and a comparatively long life. The greatest disadvantage in the use of the present day photo-electric cell, with its inherent low sensitivity, is the necessity of using high gain multi-stage pre-amplifiers to bring the output of the cell up to a level high enough to drive the power stages. This means that only the most skillfully designed apparatus can be used to obtain satisfactory reproduction.

The difficulties encountered in the use of photo-electric amplifiers with its associated apparatus are too well known to warrant elaboration at this time. Microphonism and distortion in tubes, inductive pickup, in high impedance circuits, location of delicate apparatus on or near vibrating projectors, together with complicated wiring of batteries and controls are but a few of the resultant evils.

With this in mind the engineers of the Pacific Research Laboratories set out to produce a cell with sufficient output to operate a modern power amplifier direct, thus eliminating pre-amplification with its attendant worries. Their efforts have been rewarded with a highly sensitive cell and a sturdy one with the assurance of a long life and uniformity in production.

Construction Details

This new light sensitive device is known as the "X Cell" and differs from the conventional type of photo-electric cell both in construction and

composition of the light sensitive element. The cell proper consists of two glass discs about three-quarters of an inch in diameter between which the photo-conductive surface is sealed. This latter in turn is mounted in a bakelite or metal case. The nature of the photo-conductive material cannot be disclosed at this time.

Durability

The extreme physical and electrical ruggedness of the X cell lies in the fact that no vacuum tubes or gases are used, thereby eliminating the possibilities of damage by breakage or ionization. Tests have shown that the X cell may be subjected to the direct sunlight for one thousand hours with the full voltage applied without any change in the electrical characteristics whatever. Under normal operating conditions this assures a long trouble free life.

Sensitivity

For motion picture sound work it will be interesting to note that with .4 lumens light flux (approximate amount of light obtained through the ordinary optical system) at 4.5 volts an output of one-half milliampere is obtained. This is sufficient to load up any three-stage power amplifier to capacity. In actual tests a Silver-Marshall type 692 amplifier was used working directly from the X cell through an audio transformer. In this way ample volume was obtained for a twelve hundred-seat auditorium.

In other tests using only a two-stage Loftin White amplifier enough volume was obtained to fill a room thirty by sixty feet. This fact alone opens up great possibilities in the field of portable and home talking pictures. For those interested in relay work, it will be seen that the X cell will operate without any amplification whatever a relay up to 5 milliamperes on 22.5 volts with 51.2 lumen light flux.

Coupling Mediums

The new X cell is adaptable to any means of coupling such as direct resistance, impedance or transformer. For motion picture work the X cells are manufactured with a low impedance to permit transformer coupling. With the latter type a two-transformer fader unit can be located between the projectors and leads from this run anywhere in the room to the power amplifier. Two small 4.5 volt C batteries can be located in the transformer box to supply the polarizing voltage for the cells. This makes sound-on-film as simple as disc reproduction, eliminating battery-operated head amplifiers which are a constant source of worry.

Further information on this new cell development may be had by addressing Pacific Research Laboratories, 1489 West Washington St., Los Angeles, Calif.

New Changeover Adapter for Rear Shutter Projectors

With the introduction of the rear shutter it was found that certain changeovers that were attached to the rear of the projector head would not fit there any longer because the manufacturers of rear shutters had not allowed enough space between the rear shutter housing and the projector for the box to fit in. This necessitated changes not in the rear shutter but in the changeover attachment.

A special adapter for the projection head to overcome this difficulty is now being made by the W. & W. Specialty Co., 159 West 21st St., New York. This special adapter permits the changeover box to be fitted right in, and at a very minimum expense. With this new adapter it is not necessary either to make troublesome alterations or to purchase a new changeover when changing shutters on existing heads or buying a new rear shutter projector.

This new adapter has no parts that will crack or break under ordinary usage, and it can be attached within a very few minutes, no drilling or tapping being necessary. The projectionist simply screws the adapter to the head—where the box originally was—and then screws the box down upon the adapter; then reverses the leads in the box and everything is set to run. These adapters are now being used extensively on the Fox Circuit.

Present A. C. Heater Tubes Withstand Intense Heat

Present-day heater type A. C. tubes mark an achievement of the highest order in the development of severe service materials. For one thing, the insulator tubing in most tubes must have a fusion point above 2270 deg. C., as contrasted with 1820 deg. which is the fusion point of porcelain. What is more, the insulating tubing must not warp, shrink, break, decompose or interact with the tungsten wire at this temperature. It must remain a good dielectric at glowing temperatures. Meanwhile, the tiny holes throughout the length of the tubing no larger than the lead of an ordinary lead pencil—holes hardly visible to the naked eye—must be accurate in size and evenly spaced at all times.

The short life of earlier A. C. tubes has been traced to several causes. In the first place, materials originally employed for the heater insulator were quite unsatisfactory. The severity of the service conditions was not realized. Impurities resulted in broken-down insulation. There was frequently a chemical interaction between insulating material and tungsten wire. A common cause of failure was the fusing of insulator and wire, with early breakage of both tubing and wire, due to unequal rates of expansion and contraction. Porcelains, fused quartz, alumina and other materials were tried in turn, only to prove incapable of fulfilling the extremely trying conditions.

Magnesia Great Aid

The remarkable life and performance of present-day heater type tubes, according to Henry L. Crowley of West Orange, N. J., a pioneer worker and manufacturer of synthetic ceramics, are due to the introduction of magnesia. This material eliminates the heretofore critical exhaust conditions and high shrinkage in tube production, and provides the desired operating conditions. The crolite magnesia insulated tubes now available on the market have a life of several thousand hours, and, what is more, are capable of withstanding severe voltage overloads without materially decreasing their useful life, thus solving the problem of fluctuating line voltage faced in many sections of the country. In fact, it is now possible to obtain heater type tubes superior to the filament type, due to the successful solution of the insulation problem.

New De Forest P.E. Cell

Greatly increased sensitivity is the outstanding feature of the new De Forest caesium type photo-electric cell, aside from extreme compactness. This cell, in a —99 size glass bulb, with the standard four-prong base, has an output of 35 to 75 microamperes per lumen, or several times the output of the larger potassium photo-electric cells heretofore extensively employed. As an example of its sensitivity, an automobile headlight bulb a foot away from the cell, shining through a ½-inch hole, will result in an output of 4 to 7 microamperes. To obtain a corresponding output from the potassium type cell, a large size incandescent lamp of many times as much candle-power would have to be employed as the light source.

The new De Forest caesium photo-electric cell has been employed for several months past in the radio-vision pick-up equipment of the De Forest experimental transmitting station, W2XCD, maintained at Passaic, N. J.

Blue Seal Products Co. Has Fine Equipment Record

The Contner-Blue Seal Universal Lens Adaptor and Aperture System for projecting standard and movietone film the full screen area was introduced to the trade in June, 1929. This device has met with great success to the extent that many thousands of installations have been made throughout the world. Many larger theatre circuits have adopted them as standard equipment, as they have many other Blue Seal products.

A new and important improvement

has just been developed on the film trap, and this is to use an alloy of iron in the construction instead of a white metal or lead as formerly used. These new traps are guaranteed not to warp under the intense heat of the arc spot, which is an important feature. A warped film trap changes the relation of the film passing through the gate at the aperture and will put the picture out of focus on either one side or the other on the screen, and will also cause an in and out of focus effect when projecting a warped film. A perfect trap is essential for the projection of sound pictures and the Blue Seal Co. has spared no expense to turn out a film trap for this purpose.

An installation of a Blue Seal film trap on the projector not only assures perfect projection, but means that the cost is ended. It will last the life of the machine. Many exhibitors have checked up on their past repair bills and have found that on an overhaul job, the trap has been replaced in every case, due to being warped.

New Blue Seal Products

The Blue Seal Products Co. has been manufacturing improved accessories for the projection room since 1913. Many of their improvements have been adopted by the projector manufacturers and incorporated into their projectors. At present this Company has several new improvements, now in the working, to introduce this Fall. These new devices will be announced in the various trade papers. Blue Seal's policy has always been to keep abreast with the times and in many cases a few steps ahead.

The Pentode Tube in Sound Motion Picture Work

Several months ago the technical sections of the lay press and all the technical magazines heralded the perfection of a new kind of tube, the "pentode." In the light of recent developments it appears that exaggerated claims were made for this tube at that time, for the pentode has failed to "revolutionize procedure in radio, sound motion pictures, television, and, in fact, any art that employed a vacuum tube in its electrical circuit."

At the present time nothing has materialized to justify the assertions of these revolutionary contributions, and, in fact, it is apparent that only very few serious workers in the art are experimenting further with the pentode tube with a view to simplifying amplifier circuits now in common use.

Pentode Not New

The pentode, as its name implies, is a hard-vacuum tube containing five elements: a filament, a plate, and three grids. The pentode is by no means new and is commonly known in the technical and patent literature, having been on the open market in both England and Germany for several years.

The general characteristics of the pentode as set forth by the CeCo Manufacturing Co. of Providence, R. I., are as follows:

Filament voltage	5.0 Volts
Filament current	2.00 Amperes
Plate voltage	300 Volts
Screen grid voltage	200 Volts
Control grid voltage	—16 Volts
Plate current	43 milliamps.
Screen grid voltage	9 milliamps.
Amplification factor	55
Plate resistance	22,200 Ohms
Mutual conductance	2500 Microhms
Undistorted power output	2.4 Watts
Optimum load impedance	5000 Ohms

It is apparent from the above that the output of the pentode will work directly out of a power detector and give approximately 2.4 watts of power output when worked into a dynamic speaker of about 5,000 ohms, therefore replacing a 227 and a 250 output stage of amplification. The resultant simplification in apparatus would be very advantageous in sound picture work.

A disadvantage in the use of the pentode is its microphonic characteristic, making necessary the use of shock-proof mountings.

Smokeless Flashlight Shots

The General Electric Company has just announced a new device which will do away with the smoke which follows a flashlight picture and which has made this phase of theatre work such a torment for actors and actresses.

The flash is confined entirely within a specially prepared clear bulb of standard design in which is a flashlight filament and a quantity of very thin aluminum foil in crumpled sheet form. The lamp operates on a 115-volt house supply, or with dry, storage or flashlight batteries.

When the circuit is closed the filament is lighted and this ignites the aluminum foil which, because of the presence of oxygen in the bulb, burns fiercely and quickly. The whole operation requires one one-hundredth of a second and a new bulb is needed for each flash. The device was developed in the incandescent lamp department of the company at Cleveland.

Weekly Radiovision Feature Programs Now on Air

Celebrities of stage, concert hall, journalism and public life are now being seen and heard over the air, as the climax to regular radiovision or radio television broadcasting. Next Tuesday evening, Ed. Carter, founder of the Just Kids Club, Violinist Hoffman and others will be presented to lookers-in as well as listeners-in, while news bulletins of the day will be given by the editorial staff of the New York Evening Journal, who are cooperating in the feature radiovision programs.

The present series of feature radiovision programs began last Monday evening when many well-known personalities appeared before the direct pick-up equipment in the Jenkins Television Corporation's studios in Jersey City. While each person in turn was scanned by the weird greenish light of the pick-up device, for pictorial transmission, the voice of that person was picked up by a nearby microphone, so that the complete sight and sound presentation might be made over the air.

Two Stations Used

Two complete radio stations are employed for the Jenkins feature programs. The sound signals are sent from the studio by direct wire to the De Forest experimental broadcast transmitter, W2XCD, at Passaic, for transmission on 187 meters. The signals may be tuned in at the lower end of the dial of the usual broadcast receiver. Meanwhile, the sight signals or pictures are transmitted from the Jenkins radiovision station W2XCR at Jersey City, on 107.1 meters. At the home end, a short-wave receiver with radiovisor, together with a standard broadcast receiver, serves to tune in the sight and sound components for the complete presentation.

RCA Sound Projection School Completes Course

The second semester in the course of instruction for sound projectionists conducted in the classroom of the RCA Photophone installation and service department, No. 438 West Thirty-seventh street, New York City, has been completed.

The course extended over a period of seventeen weeks and covered the fundamental principles of sound and electricity, the theory and operation of rectifying and amplifying tubes, as well as a detailed study of all types of Photophone reproducing equipment.

Three class sessions of two hours each were held daily from Monday to Friday, the same lecture being repeated during the entire week.

Written Examinations

A written examination was held and all students who met the requirements received a card certifying that they had satisfactorily completed the course and had proved themselves competent in the theory and operation of Photophone equipment.

The course was attended by projectionists who are members of Local 306 of New York City, Local 640 of Long Island, Local 384 of Jersey City, Local 650 of Westchester County, Local 362 of Paterson, New Jersey; Local 449 of Stamford, Conn.; Local 277 of Bridgeport, Conn., and Local 645 of Nyack, N. Y.

Everyday Science

Research Shows Effect of Electrocution on the Brain

HOW electrocution kills its victims by destroying the internal structure of nerve cells in the lower part of the brain called the medulla, so that these cells no longer discharge their duty of regulating breathing, has been reported to the American Medical Association by Dr. O. R. Langworthy, of Baltimore, Md. Dr. Langworthy obtained small samples of nerve and brain tissue from the bodies of two individuals killed by electricity; one of them a suicide, the other a criminal who was electrocuted.

In both bodies the nerve cells of this medulla, between the brain and the spinal cord, showed damages visible under the microscope. The central nuclei of the cells, believed by physiologists to be the mechanisms which control the cells' activities, were displaced from their usual positions and altered in character so that they absorbed more than usual of the dyes which microscopists use to stain and make visible such structures inside the cells.

Novel Aspects of Case

Other structures of the cells seemed also to be disorganized and partly destroyed. Although the suicide victim received the current between the left arm and the left leg, so that the electricity did not pass directly through the brain, the same injuries to nerve and brain cells were found as in the other case, suggesting that these cells in the medulla are especially sensitive to electric shock. This also explains why one of the first effects of an electric shock is to stop breathing, since that is a bodily activity which these cells control.

Sun Gods and Violet Rays

Sun worship, in the light of modern discoveries, was not so foolish after all. The ancients knew that the sun was essential to the healthy development of plant and animal life. Consequently, temples were built and sacrifices made so that the sun god would smile and shine. Today there is in effect a reincarnation of the ancient Ra. Man and his science have brought forth an efficacious, though synthetic, sun god in the production of ultraviolet radiations.

By means of the electric arc it is possible now to obtain radiations which, for practical purposes, approximate sunlight. They have a very definite therapeutic value to mankind. Their curative and stimulating effects have been thoroughly demonstrated for some diseases and the medical fraternity is administering "light" treatment quite extensively. Even the normal healthy person has found that consistent exposure under the sunlight lamp is good insurance against common cold and "flu."

However, the use of ultraviolet lamps by the public is far from general because of lack of knowledge of what the so-called ultraviolet ray will do. There is also the suspicion that the high priests among the modern sun-makers are "holding out on" the public that they may profit themselves.

Eliminate Harmful Rays

It is true that much still remains to be learned of these radiations and that their intemperate or careless application may prove rather painful to the individual. But there is equipment now available which will produce the same effect as sunlight and from which radiations of undesirable or dangerous wave-lengths have been eliminated. Most of this equipment is relatively expensive; still, it is not beyond the reach of moderate incomes, particularly if the expenditure spells health.

By use of the ultraviolet lamp it is entirely possible for a person to "take his sunlight" with no more difficulty than he regulates his diet. Results indicate also that these rays, which impinge upon the exterior of the human anatomy, may be infinitely more beneficial than many articles of diet which find their way into the interior. A little more synthetic sun worship can do modern man a lot of good.

Artificial Rain-Making

A new way of making rain artificially by sprinkling super-cold ice crystals from an airplane has been tried in Holland. Ordinary ice is shaved or broken into very tiny grains almost as fine as snowflakes. This powdered ice then is cooled in a refrigerating machine to a point much below the freezing point so that it becomes a kind of extremely cold sand, the super-frozen ice crystals seeming as dry and hard as ordinary sand grains would be. Protected from melting by a covering to keep out the heat of the air, these ice grains then are taken up in an airplane and sprinkled into the air, much as a streetcar motorman sprinkles sand on a slippery rail.

In recent trials over the Zuider Zee, it is reported, this sprinkling of the air with ice-sand resulted in sufficient cooling to cause the formation of a thick cloud and the fall of a little actual rain. The action of the ice-sand was observed from other airplanes flying below the one doing the sprinkling.

Advocates of the new method do not claim that it will make it possible to break actual drouths like that which occurred in the United States this summer or to create heavy widespread rains. It is hoped, however, that local rains sometimes may be caused to save especially valuable crops in case of local drouth, like the crops of tulips or of early spring vegetables for the markets of Paris and London which are exceptionally important to the farmers of Holland.

Iron Leads Appliances

Of all electrical appliances sold in the United States each year, the electric flat iron leads all others, the number sold in 1929 being 3,150,000, an increase of 5 per cent over the previous year. It is estimated that out of a total of nearly 20,000,000 electrified homes in the United States, 94 per cent use electric flat irons. Electric toasters come second, the total for 1929 being 1,540,000, an increase of 10 per cent over the previous year. Vacuum cleaners totaled 1,312,000, and clothes washing machines 1,019,000.

Coffee percolators totaled 1,295,800, of which 800,000 were made of aluminum and the remainder of brass, copper plated. A total of 178,000 electric ranges were sold, and refrigerators for domestic use totaled 630,000.

40° Below Zero Refrigerator

A manufacturer of domestic electric refrigerators recently completed a special unit for a rubber manufacturing plant. This refrigerator is guaranteed by the maker to maintain a temperature of 40 degrees below zero.

The construction of the unit is not essentially different from that of the regular output of the company with the exception of the thickness of the walls of the refrigerator itself. The refrigerators made for domestic trade have approximately three inches of cork insulation all around, whereas this special unit for 40 degrees below zero has both walls and doors lined with 10 inches of solid cork.

This special refrigerator is to be used by the rubber manufacturer for testing automotive equipment which will be sent into the polar regions.

New Child-Growth Theory

Scotch children grow taller chiefly in the spring months, between March and June, but gain weight chiefly in the summer months between July and September. So it has been discov-

ered by Dr. J. B. Orr and Mr. M. L. Clark of the Rowett Research Institute of Aberdeen, Scotland, who measured and weighed four times a year 657 children between the ages of 7 and 11 in the Scottish towns of Glasgow, Edinburgh, Dundee, Peterhead and Greenock.

The average increase of height of the boys between March and June, the measurement showed, averaged nearly three-quarters of an inch. Girls grew even a little more than boys, on the average, during this quarter. During the summer quarter, June to September, increase in height of boys and girls alike averaged less than half an inch and during the two winter quarters of the year growth in height was still less.

Grow More in Spring

The spring quarter thus shown to be the time of maximum growth turned out, however, to be a poor time for increases of weight. Some of the children actually decreased in weight during the spring although they continued to grow taller. In the summer quarter, however, both boys and girls got notably fatter, the average increase of weight being nearly two pounds, as compared with an average of less than one pound during the spring and late winter and only about a pound and one-quarter during the months between October and December.

Doubtless some such weather factor as varying temperature or varying amounts of ultraviolet rays is responsible for these newly discovered growth differences but Dr. Orr and Mr. Clark venture no theory of what these weather influences may be.

See Mountains 500 Miles Away By Lightning Mirage

A night-time mirage of the High Atlas Mountains in northern Africa, seen from five hundred miles away by the lightning flashes of a thunderstorm is the remarkable phenomenon reported recently to the French Academy of Sciences, in Paris, by M. Jean Lugeon, who was measuring the electrical state of the atmosphere at El Golea, on the northern edge of the Sahara Desert.

Mountains 500 Miles Distant

One night while observations were being made on the summit of a small hill about three hundred feet high, M. Lugeon's party was astonished to see in the northwestern sky a band of light, close to the horizon. After a moment there flashed into view great, snow-covered mountain peaks brilliantly lit by incessant lightning flashes. On another evening the vision was repeated. The only mountains in that direction, and indeed the only high mountains in that part of Africa, are those of the High Atlas range, located, M. Lugeon reports, about 800 kilometers or almost 500 miles from his point of observation. This distance is so great that a direct sight of the mountains would be impossible because of the curvature of the earth.

Case a Rarity

Accordingly, the sight which M. Lugeon and his companions got of the giant range must have been a mirage due to the bending of light rays; one of the few examples of night-time mirages ever recorded, and so far as known the first one to be observed by lightning. M. Lugeon took the trouble to confirm this theory by discovering from the Moroccan weather service that violent thunderstorms actually were in progress in and about the Atlas range on the nights when the mirages were seen.

Anglo-Europe 'Phone Progress

Telephone service between England and continental Europe was inaugurated in April, 1891, when two circuits were completed between London and Paris. It was not until 12 years later, in 1903, that communication with Belgium was established with two London-Brussels circuits.

During the war, the telephone repeater came into existence in the United States, where it was perfected by engineers of the American Telephone and Telegraph Company for use in the first transcontinental line, uniting the Atlantic and Pacific Coasts, which was then being completed. The development of the telephone repeater at once attracted attention in Europe, where it was used on an extensive scale during the war.

57 Circuits Now

Following the war, the first task was that of providing sufficient plant to meet demands for internal services, but by 1922, extensions of internal services began, with the results that in September of that year an Anglo-Dutch service was opened, with two circuits between London, Amsterdam and Rotterdam. Since that time communication with the continent has increased to such an extent that there are now fifty-seven Anglo-Continental circuits in operation as compared with 13 in August of 1914.

On the Anglo-French, Anglo-Belgian and the Anglo-Swiss circuits, the French language is employed for operating purposes, but on the other routes a considerable amount of English and German is used.

The first-rate technician is generally much more interested in his craft than in his personal fame, or even in his life. In order to obtain the necessary conditions to create a masterpiece or perfect a new process he is perfectly willing to lose himself in a glorious anonymity. The architects of many of the world's greatest buildings, like the great inventors, are often unknown, and generally mere names. The knowledge that this would be so would not have distressed them.—J. B. S. HALDANE, *British Scientist.*

Electrical Porcelain Made in Various Processes

Porcelain is a vitreous homogeneous mixture of clay, flint and feldspar. Porcelain which is used for electrical purposes differs from general porcelain ware only in the proportion of the three base materials used, and in the refinements of its manufacture. These differences, however, make possible a porcelain which meets the highest mechanical and dielectric requirements.

The raw materials are finely ground, accurately proportioned and intimately mixed in a liquid state. The mixed material is then reduced to a plastic state by filtering under pressure. Electrical porcelain is manufactured by three processes, the casting process, the dry process and the wet process.

Dry Process

After filtering, the material is partly dried and ground to a crumbly condition, in which the granules are the size of rice grains, or smaller, and in which there is just enough moisture so that a handful of the material will cling together when squeezed. The material is then pressed into moulds of the required shape. The pressed shapes are dried, finished to dimension and glazed. Dry process porcelain can be moulded quite accurately into complicated shapes.

Casting Process

Porcelains of high dielectric strength and of complicated form can be made by pouring the liquid material into multipart plaster of paris moulds. The cast piece is removed from the mould after it has stiffened sufficiently to permit handling and finishing without distortion. It is then thoroughly dried and glazed. Plaster of paris is a particularly useful material for moulds because it accelerates the drying of the porcelain body by its absorption of moisture.

Wet Process

Blocks of plastic material about the consistency of putty are worked into the desired shape, and placed into plaster of paris moulds. The surface not in contact with the mould is then worked to the desired shape by machine forming and pressing. The piece is removed from the mould after it is partly dried and stiff enough to handle. The surface which was in contact with the mould during the pressing operation is finished to accurate dimensions. The body is then thoroughly dried and glazed.

ERPI'S Acoustic Consulting Dept.

ELECTRICAL Research Products announces the formation of an Acoustic Consulting Department. This department is an expansion of the Theatre Acoustic Department which, during the past year has made acoustic surveys of and acoustic recommendations to more than 4,000 motion picture theatres using the Western Electric sound system. It is now being expanded to meet the demands for its services outside of the theatrical field.

Sidney K. Wolf, who has guided the Theatre Acoustic Department since its inception, is Director of the new organization. G. T. Stanton has been named Assistant Director in the East, and A. P. Hill, Assistant Director at the West Coast. Working under their supervision is a staff of 15 experienced acoustic engineers. The department's consulting services for surveys and recommendations for acoustic efficiency and noise elimination or abatement will cover a wide field. They will be available to architects, builders, office and factory managers, contractors, private home owners and civic institutions.

In every instance the department aims to make its surveys and recommendations on the basis of economic noise level. Defined in lay language that means the minimum to which it is profitably possible to reduce noise and improve acoustic conditions. For the furtherance of its work the department will have not only the experience of its trained engineers and the engineers of the Bell Laboratories, but also special apparatus developed by the Bell Telephone Laboratories for measuring the quantity of noise as well as a complete acoustic analysis of practically every material that goes into home or building construction or furnishing.

In announcing the formation of the new department Director Wolf laid emphasis upon these two points: "Without this special apparatus developed by the Bell Telephone Laboratories, but relying solely on our ears, it would be impossible for us to accomplish our present results," he said. "The apparatus which we have been using for a year in our theatre acoustic work enables an organization of this nature for the first time to accurately measure the quantity and quality of noise, distribution of sound, amount of reverberation and to determine the necessary corrective measures. In our files we have a complete acoustic analysis of materials used for building and furnishing. The fact that we have no connection with the sale of any of these materials enables us to make our recommendations impartially."

Pre-Construction Advice

As an outgrowth of its acoustic surveys and recommendations to motion picture theatres, its advice is now being sought by builders of new theatres, auditoriums, convention halls, etc., before the plans are completed.

A further possibility for its consultation services lies among machinery manufacturers who are anxious to consider the reduction of noise in machinery from the standpoint of its manufacture as well as from its actual operation. In the field of laboratory work the department aims through the resources of the Bell Telephone Laboratories to still further experiment on the problem of acoustic efficiency and noise elimination. This branch of the work will include theoretical research and also the development of further instruments to be used in measuring noise.

Aerovox Condenser Manual

A new 32-page manual on electrolytic condensers, their uses, advantages, and limitations, with detailed data and characteristics of the Aerovox Hi-Farad dry electrolytic condenser has just been published by the Aerovox Wireless Corp. of 70 Washington St., Brooklyn, N. Y. Copies of this booklet may be had free of charge by addressing Aerovox.

STOP GUESSING

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DON'T GUESS . . . USE CUE-METERS

Some Aspects of National Electric Code

(*Continued from page* 23)

signals through momentary contact push buttons.

From the brief description of only the circuits involving the interlocking distributor system, it is readily seen how complex the conduit system would be if strict adherence to Section 503*n* of the Code were enforced.

Battery Supply

In connection with the battery supply, "B" battery energy is usually furnished by the same set of batteries at 350 and 130 volts. These batteries are charged from the 1½ kw., 120 volt d.c. motor generator mentioned above, the driving motor of which, as already stated, is connected to the 3-phase, 220 volt house supply.

The "A" battery supply of 6 volts is obtained from one high capacity set of storage batteries and the 12 volt "A" battery supply from another high capacity set. Both sets are charged by a combination 7½—15 volt special d.c. motor generator set, the driving motor of which is also connected to the 3-phase, 220 volt house supply.

On the stages themselves, microphone junction boxes are installed which contain a 130 volt local dry "B" battery connected to the microphone amplifier. A 6 volt "A" battery supply is also brought to this same terminal point as well as six pairs of No. 19 twisted lead-covered conductors which run to the monitoring room for microphone output. At these junction boxes, the multiple point pin plug receptacles provided are arranged with a ground connection for the continuous electrostatic shielding and grounding.

These descriptions of interconnected electrical systems of various voltages and characteristics are not given as a treatise on the electrical circuits of sound recording, for this is neither the scope of this paper nor a task which the writer is prepared to undertake, but are given merely to indicate the complexity of the many problems which the Code Committee must work out.

New Code Requirements

In order to provide all the safety possible and at the same time to permit reasonable methods to be used which will not hinder nor interfere with development and progress in this branch of the art, a subcommittee of the National Fire Protection Association has been delegated to work out this problem and will submit to the Electrical Committee which meets in February, 1931, the following recommendations dealing with sound recording and reproduction for inclusion as rules in the next issue of the National Electric Code:

3502 (*a*) Automatic overload protective devices shall be provided in accordance with the requirements of Article 8 of this Code. The smallest practical rating or adjustment with which the apparatus will operate should preferably be used. Circuits to supply "B" or "C" voltage shall be protected by automatic overload protective devices rated at not more than 1 ampere.

(*b*) Wires may be grouped in the same conduit, armored cable, metal raceway, pull box, junction box, or flexible cord, types K, S, or SJ, between receptacles and loud speakers or camera booths, under conditions as noted in sub-paragraphs 1 to 5 below, provided all wires have insulation rated for the maximum voltage applied to any wire. In no case shall the insulation requirements be less than those required for 600 volts.

1. Wires emanating from the same piece of apparatus and/or terminating in the same piece of apparatus.

2. Wires that carry current from a primary source which is used to drive a motor whose speed is electrically controlled, or to drive a group of motors operating in synchronism may be run in the same conduit, *etc.*, with wires that carry other currents of characteristics differing from the characteristics of the primary current, required for the operation and/or synchronization of a motor or group of motors.

3. Wires to loud speaker fields and armatures, also from receptacles to camera booths provided

Screen moods expressed in

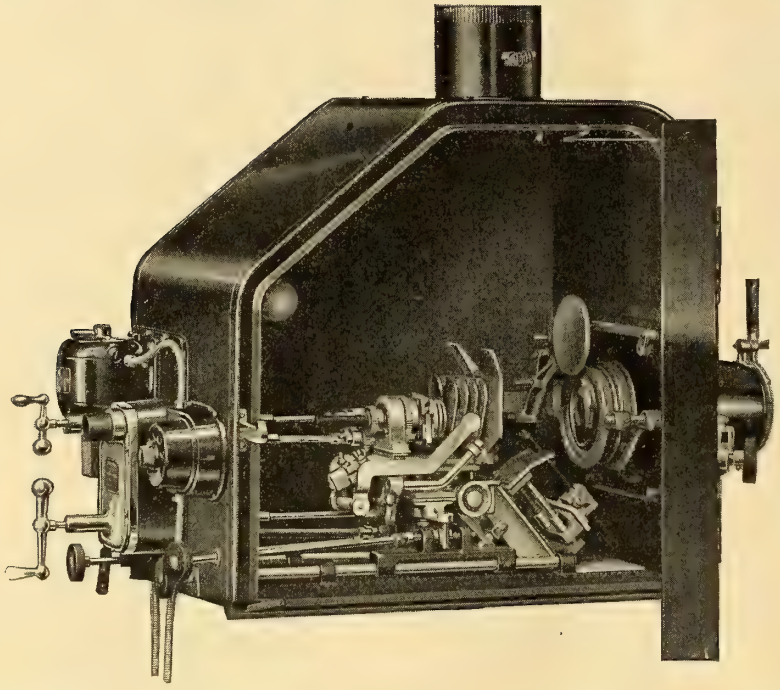
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that when receptacles and plugs are used they shall be of polarized type.

4. Wires from the projector sound head and/or turntable to amplifier equipment.

5. Wires to supply "A," "B" and "C" voltage from motor generators and batteries provided they are protected by automatic overload protective devices installed at the nearest accessible point to the batteries or generators.

(*c*) Input leads to a motor generator or to a rotary converter shall be run separately from wires emanating therefrom.

(*d*) Storage batteries shall be installed in accordance with proposed requirements of revised Article 18.

(*e*) Insulation of wires exposed to oil or oil dripping shall be of a type approved for interior wiring that will not be injured by oil or shall be protected from such injury by a seamless metallic covering over the insulation.

(*g*) Wires terminating in groups at patch panels or similar connection boards shall be covered with a single wrapping of asbestos tape or equivalent material over convenient groups. This is not required where the metallic covering is carried to within 6 inches of the terminals.

(*h*) Wires to or from "A" batteries shall be run in conduit or duct compartments and separated from all other wires, unless all wires and cables in the same conduit or duct are sheathed with lead or other approved shielding.

Revised Code on Batteries

1801—*General*

(*a*) The provisions of this article are intended to apply to all stationary installations of storage batteries consisting of a number of cells connected in series with a nominal potential in excess of 16 volts and connected for service where so installed.

(*b*) Wiring and appliances supplied with current from such storage battery installations shall be subject to the general requirements of this Code applying to wiring and appliances fed from generators developing the same difference of potential.

1802—*Battery Room*

(*a*) Provision shall be made for a sufficient diffusion of the gases from the battery to prevent the accumulation of an explosive mixture in the battery room. (NOTE: Normally, natural means of ventilation are sufficient. The closed closet type of battery installation shall not be permitted.)

(*b*) Wiring shall be inclosed in non-corrodible or suitably protected conduit system, or shall be exposed and installed in accordance with the requirements of Section 501 of this Code, except that in battery rooms varnished cloth or tape insulated conductors shall not be permitted, and except that bare conductors may be used in the battery room when properly supported. Where metallic conduit or covering is used in the battery room, at least 12 in. of the conductor at the end connected to cell terminal shall be free from such metallic conduit or covering, and the end of the conduit or covering shall

be sealed tightly to resist the entrance of acid or acid fumes.

1803—*Batteries not over 250 volts (nominal) potential.*

(*a*) Cells in series circuit not over 250 volts shall be subject to the following provisions for additional insulation.

(*b*) Cells in lead-lined wood tanks, not over 50 volts series circuit, shall be supported individually on glass or glazed porcelain insulators; over 50 volts, on oil insulators.

(*c*) Cells in jars made of conducting material shall be installed in trays of non-conducting material supported on glass or glazed porcelain insulators, with not over 16 volts in series circuit in any one such tray.

(*d*) Cells in unsealed jars made of non-conducting material shall be assembled in trays supported on glass or glazed porcelain insulators; or, when installed on a rack, shall be supported in groups on glass or other insulating members.

(*e*) Cells in sealed rubber or composition jars, assembled in wood trays, shall have such trays supported on glass or other approved insulators.

(*f*) Cells in sealed rubber or composition containers, without wood trays, shall require no additional insulation when not over 150 volts in series circuit; when over 150 volts, shall be installed in trays or on racks with not over 150 volts in series circuit, each such tray or rack to be supported on glass or glazed porcelain insulators.

(*g*) Cells in sealed glass jars, either with or without wood trays, shall require no additional insulation.

1805—*Racks and Trays*

(*a*) Racks, as specified in this article, refer to either (1) wood racks coated with an acid resisting material; or, (2) metallic racks coated with acid resisting material and provided with non-conducting members for the support of the battery.

(*b*) Trays, as specified, refer to crates or trays made of wood or other non-conducting material, and when not of glass, rubber, or composition shall be coated with acid resisting material.

There are still a great many more items in the studio, laboratory and theater for which the present National Electric Code does not make adequate provision and with which the Code Committee is greatly concerned.

Grounding and Attachment Plugs

There has been considerable discussion resulting in special local requirements in which the use of the ordinary attachment plug and receptacle is prohibited in locations where film is handled.

In New York territory, the local inspection departments are requiring the use of a plug and receptacle device where the arc established by the pulling out of a plug is confined to the inside of the receptacle before the pins of the plug are completely withdrawn, thereby eliminating the possibility of igniting a piece of film which might be in proximity with such a plug and receptacle. This has been accomplished in various ways. One is to enclose the complete receptacle and plug in a cabinet with a self-closing cover slotted to permit the cord to pass through. When the plug is pulled out of the receptacle, the cover is still closed. Another device is designed with a metallic skirt deep enough to permit the pins of the plug breaking contact while the pins are still completely enclosed. As far as the writer knows, the matter is still being discussed by the Code Committees and some standard construction for these devices will probably be incorporated in its February, 1931, report.

Vapor Proof Fixtures

The question of vapor proof fixtures in buildings where film is handled is well known to most of us. Most of the local inspection departments are requesting the use of vapor proof fixtures not only in film vaults but also in rooms where film is worked, as well as in corridors leading to such rooms. This applies equally to rooms in which sound film recording machinery is located.

There seems to be considerable difference of opinion regarding the real necessity for vapor proof fixtures. One inspection department in New York requires vapor proof fixtures, but will also accept the use of a metal dish under the lamp when located in film working rooms; in other words, a fixture similar to the totally indirect unit. This is merely a precaution to

(*Continued on page 43*)

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16 "Don'ts" on W. E. Equipment

By HAROLD B. SANTEE

Director of Theatre Engineering, ERPI

1. *Don't Experiment with the Equipment.*

The life of the equipment will almost certainly be shortened, and inferior quality will result, if the equipment is experimented with, or operated in a manner different from that specified in our operating instructions. Both design and operating instructions are based on long and wide experience with this class of equipment, and there is, therefore, practically no likelihood that anything will be gained by changes, unless made after careful study by those thoroughly familiar with the theory, design, and manufacture of the equipment.

2. *Don't Use Unauthorized Parts.*

Such parts of the equipment as are subject to wear and deterioration with use may need replacing. A stock of the spare parts supplied or recommended by us should therefore be maintained by the theatre for replacement use. These spare parts should be carefully stored and marked, and their use and placement thoroughly understood, so that replacements can be made with a minimum loss of time in emergencies.

To use unauthorized parts may result in inferior reproduction and unsatisfactory operation of the equipment, or in permanent damage to it. As spare parts are used up, others should be ordered to take their places and maintain the stock. All the component parts of the equipment are specifically designed for the use made of them, and to get the best results from this equipment it must be operated in accordance with the requirements that determined its design.

3. *Don't Neglect Equipment.*

Inspect the equipment and observe at all times whether it is normal. Set screws that have become loose must be tightened. If any misalignment exists it must be remedied. Overheating of rheostats and overheating of equipment are indicative of faults that must be remedied to insure the proper running of a show.

4. *Don't Use Misadjusted, Defective or Deteriorated Equipment.*

Any equipment that gives any indication of being in any way abnormal must be replaced or brought to the attention of the Service Engineer. The focus of the exciting lamp must be exact, for the reproduction depends upon the intensity of the illumination on the film track. If a filament in the exciting lamp sags or is not straight, or if the inside of the glass becomes coated with a black deposit, it should be changed. Vacuum tubes showing bright spots on the filaments or otherwise abnormal should be replaced to avoid failure during an exhibition.

5. *Don't Ignore Meter Readings.*

The various meter readings are given in the operating instruction book. When the meter readings differ from these values, or when the meter readings cannot be adjusted to the value specified, location and remedy of the cause may prevent the equipment from failing during a show.

6. *Don't Operate Tubes at Other Than Specified Current Values.*

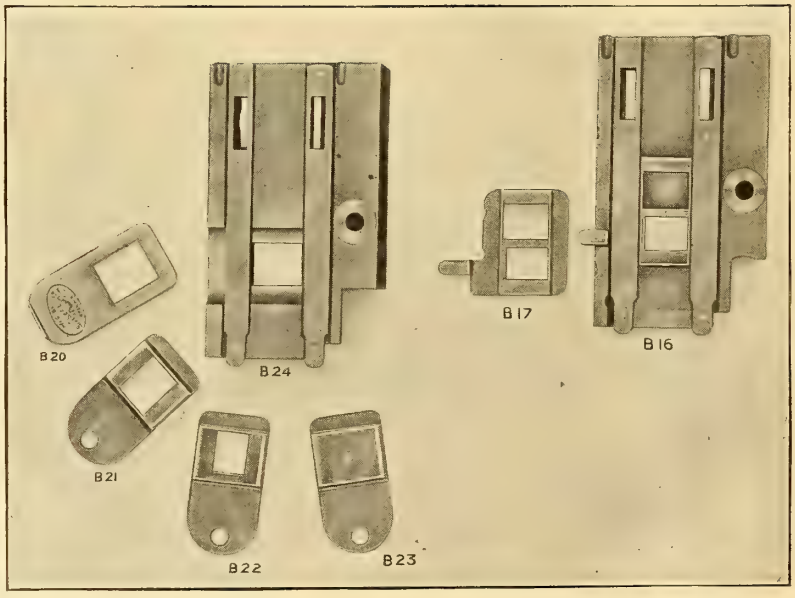
The operating instructions fully describe the current values at which tubes should be operated. To deviate from these by running at lower than specified values may result in insufficient volume or poor quality of reproduction. To operate at values greater than those specified greatly reduces the life of the tubes.

7. *Don't Install Fuses of Sizes Other Than Specified.*

To install a fuse of a lower capacity than that required may result in an unwarranted interruption of the show, due to the fuse burning out under conditions that would not cause the proper size fuse to blow out. To use fuses of greater than specified capacity will not adequately protect

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B-16 Film Traps with Sliding Double Round Corner Apertures, one Aperture for Disc and Silent Film and one cut Proportional for Movietone Film to be used with our Adaptors....	$30.00
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the equipment, and may result in permanent damage to the equipment when abnormal conditions exist and a fuse does not blow out to protect the equipment.

8. *Don't Operate Switches in Other Than the Sequence Specified.*

To protect the equipment from damage, the sequence of operation of switches specified in the Operating Instructions must not be deviated from.

9. *Don't Oil Oilless Bearings.*

Oiling instructions are given for all parts of the equipment. These instructions should be rigidly adhered to, both as to the frequency of oiling and the quantity required. To neglect to do so may result in a failure of the equipment to function. Oil should not be applied to parts that do not require it. The bearings of tension pulleys used in the drive of 206-type reproducers are of the oilless type. Oil on these bearings causes them to stick, with the result that the equipment becomes inoperative.

10. *Don't Neglect to Keep Apparatus Clean.*

The successful operation of the equipment depends on its being kept clean and in good running order. Excess oil and grease must be carefully wiped off. Dust and dirt must be wiped off the tops of batteries, so that a short circuit path will not develop. Emulsion must not be allowed to accumulate on sprockets, idlers, or film tracks, but must be carefully removed by wiping with a cloth and not scraping with a knife.

To scrape off emulsion with a knife may injure the surface over which the film must run, resulting in scratched film. The film itself must be kept free of oil, dust, dirt and fingerprints to get the best possible quality of reproduction.

11. *Don't Thread Film Carelessly*

In order to have perfect synchronization the various loops specified in the operating instructions must be strictly adhered to in threading the film, both in the projector head and in the sound reproducer. Improper threading may result in film damage and a show interruption.

12. *Don't Allow Poor Quality of Reproduction*

As soon as it is evident that the quality of reproduction is poor, endeavor to locate and clear the cause immediately. When the projectionist cannot locate and clear the trouble, the Service Engineer should be notified, so that the condition may be remedied as soon as possible. When the quality is poor the condition may be made somewhat less conspicuous by decreasing the volume when normal volume is not necessary for the audience to follow the picture.

13. *Don't Turn on Theatre Horns When Not Giving a Performance*

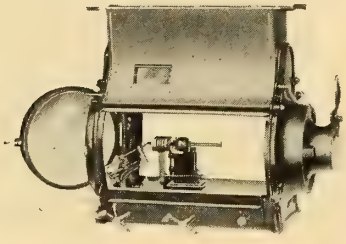
The theatre horns should be turned off when no show is being run, for



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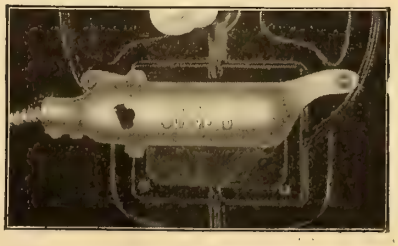
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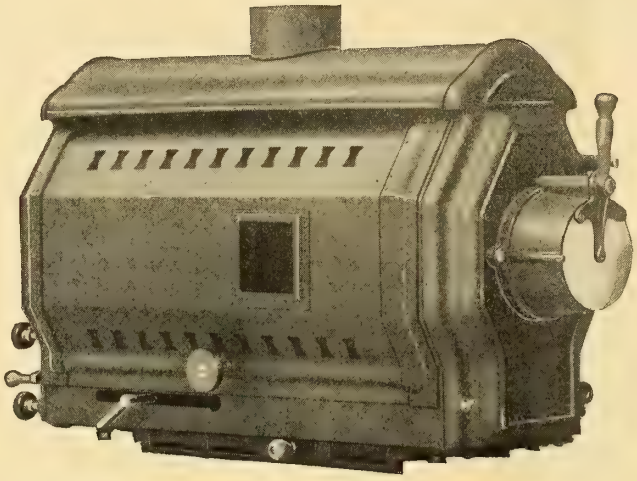
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disconcerting noises may be transmitted to the theatre from the horns when the projectionists are working on the equipment in the booth.

14. *Don't Forget to Turn Off System When Power Fails.*

In the event of a power failure during running of show the entire system should be shut down. The fader should be turned to zero first, so that the unpleasant change of pitch due to the motor slowing down will not be heard by the audience. The amplifier and power switch should also be turned off, so that when the power service is again resumed these switches will be turned on in their proper sequence as is essential to protect the equipment from damage.

Should the power be off for such a period of time that the tubes would cool and the power then be turned on, the tubes themselves might be injured and the various transformers, condensers, and electrical equipment, associated in the various circuits might be damaged if these switches were not turned on in the proper sequence.

15. *Don't Neglect Office Routine*

When equipment must be returned to the warehouse as directed by the Service Engineer, the routine for returning the equipment must be strictly adhered to, otherwise the equipment may become lost and the exhibitor would be charged for it. Return only parts of the Western Electric sound system.

16. *Don't Fail to Consult Your Service Engineer.*

Whenever in doubt about anything consult your Service Engineer, who is available to supply any information or assistance required so that the equipment may be operated to produce the best results. Periodic visits are made by the service man to ascertain whether the equipment is in satisfactory condition and to consult about matters pertaining to the equipment.

Additive Color Process

Processes of color photography all date back to the classic experiment of Clerk Maxwell before the Royal Institution in London, England, on May, 1861. On this occasion Maxwell demonstrated that any shade of colored light could be produced by combining various amounts of three primary colors, red, green, and blue-violet.

He used three separate lanterns and placed colored solutions before the lens of each. Ferric sulfocyanide was used for the red solution, cupric chloride for the green, and an ammoniacal solution of copper sulphate for the blue. When the light from all three lanterns was projected on the same spot on the screen, a white area appeared; when the red and green beams were superimposed, a yellow spot was obtained; with red and blue, a magenta spot, and with green and blue, a blue-green spot.

National Electric Code

(*Continued from page* 39)

catch the hot filament of a broken lamp and prevent its dropping upon and igniting film. If this practice is sound, the problem of properly lighting film work rooms is not a serious one as many commercial type fixtures can be obtained in this form. However, if the use of vapor proof fixtures is enforced in all locations, the problem of good lighting will assume a more complicated and expensive form.

New local rules in New York prohibit the use of chain fixtures with cords laced in and out of the rings, or drop cords in rooms where film is handled. All such units must have the fixture wires properly enclosed in a metal pipe stem. This applies as well to Wrattan safelight units which heretofore were connected by means of a flexible cord into a lamp receptacle located at some convenient point near the safelight.

The question has been raised regarding the use of wall switches in rooms where film is handled. The Code now prohibits the use of switches in vaults but serious thought is also being given to the advisability of requiring the use of vapor proof type switches in all rooms where film is handled. Attention is also being given to the use of wall fans in similar locations, especially of the types with commutators and with rheostats in the bases.

To definitely establish in the minds of the Code Committee whether there is a necessity for such devices will depend largely on a definite conclusion regarding the combustibility or explosiveness of the gases which are given off by motion picture film under ordinary conditions. These facts can best be obtained from the membership of our own Society, and any discussions or suggestions offered by you will be gladly received and considered by the Code Committee of the National Fire Protection Association.

Theatre Wiring

The use of three-wire branch circuits in commercial building is permitted by the Code but since all present dimmer installations are being made so that the dimmers are connected into the neutral or grounded leg, the Code Committee is now considering prohibiting the use of three-wire circuits in any theaters or auditoriums where dimmers are to be installed.

Past experience has indicated that contractors and wiremen are misled by the fact that the neutral leg of a three-wire circuit carries no current when the circuit is evenly balanced; but in installations where dimmers are connected into the neutral, the so-called three-wire circuit does not and cannot exist. What has really occurred is that the installation man has used a common return for two two-wire circuits, usually of the same size wire as the outside circuit legs; obviously twice as much current is carried by this common return as the remaining leg of either circuit, producing an overload on this one wire which is not a neutral of a three-wire circuit. There would be no objection to running a wire of twice the capacity for a common return, but the surer method would be to enforce the use of two-wire circuits entirely for installations of this kind.

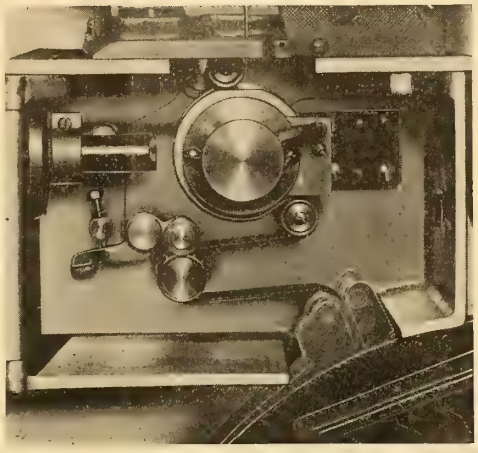
Neutral wires should terminate in the magazine panel, and be connected to separate terminals opposite the live terminals of the corresponding circuits and not to common grounding busses as is customary in commercial installations. By arranging the connection terminals thus, the electrical inspector can, at a glance, check whether the circuits have been run as two-wire circuits, especially when one of them is a grounded conductor.

The conductor leading to the dimmer plate should have a capacity equal to the sum total of the capacities of the various two-wire circuits. A common ground bus is now frequently used to tie together all common terminals of the dimmer plates.

Switchboard manufacturers should pay more attention to the routing and grouping of bus bars and branch feeders so that opposite polarities on

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a.c. systems are always together. The contractor likewise should exercise caution in the running of wires in the gutter spaces and between the magazine panels and the switchboard or dimmers so that wires of opposite polarities are always grouped through bushings, conduits, or other metallic ducts. Where this practice is not carefully observed considerable "a.c. hum," inductive and eddy current heating of the conductors and iron is produced, with consequent damage to the installation.

Technical developments frequently involve changes in methods that may not be covered by the current Code or may be infractions of it.

It is the purpose of the National Electric Code to provide safety but not to hamper development. Therefore, when such conflicts arise, it is advisable to bring these promptly to the attention of the local Inspection Bureau for a temporary ruling until suitable provisions can be inserted in the National Electric Code. Any precautions adopted that will safeguard property and insure the safety of the employees and the public will redound to the credit of the industry.

Discussion

MR. SAMUELS: In the case of motor generator sets operating with arcs, we have been frequently confronted with a situation where a motor generator operating on 200 amperes continuously and 400 amperes for the change-over interval of ten or fifteen minutes, had feeders installed for only 200 amperes. Motor generators for projection are distinguished for their flat voltage characteristics. This use of cables too small for the load causes a considerable voltage drop and defeats the purpose for which the equipment is designed. We have found several cases in the last six months where the inspector has passed a 200 ampere cable running to the projection room from a 400 ampere machine. What I would like to know is, what provision is being made by the Code to enforce the installation of the proper size conductors for d.c. feeds to booths?

MR. MANHEIMER: In connection with motor generator d.c. feeds to projection rooms, the inspectors usually are concerned only with the size of the feeder in so far as the fuses which protect it are concerned. If a feeder requires 400 amperes momentary carrying capacity, it is up to the customer to insist that the contractor install cables of such size as will safely carry this amount of current. In a new theater the wiring is installed long before the motor generator sets arrive, and it has been frequently found that when the sizes of projection feeders are specified, they are of insufficient size for the total output of the larger motor generator sets which so many theaters are now installing.

The inspector, in passing on a motor generator installation, usually checks the size of the a.c. feeder to see if it is large enough according to the a.c. motor name plate rating. On the d.c. end, he is principally con-

cerned with the sizes of the fuses that protect the outgoing d.c. feeder, and if these fuses do not exceed the capacity of the feeder, the job is passed. After the inspector leaves the job, however, it is a simple matter, by the use of refillable fuses, to insert additional links having capacities two or three times greater. This is a most unfortunate condition which only frequent re-inspection can eliminate. It would, therefore, seem advisable that the inspectors on their periodic visits to the theaters check the fuses on d.c. motor generator feeds.

Many of the chain theater construction departments now specify wire no smaller than 500,000 circular mills for the d.c. booth feeders. These have a capacity of 400 amperes per leg, and are usually large enough to carry two projection machine arcs and one stereopticon or spotlight simultaneously.

MR. R. C. HUBBARD: In connection with the matter of switches and fixtures in film handling rooms, Mr. Manheimer solicits information regarding the explosive gases given off by film. I think we should go on record with the fact that no explosive gases are given off by film until it becomes heated to abnormal temperatures and that there is, therefore, no necessity for vapor proof fixtures in film handling rooms.

MR. MANHEIMER: I should like that particular point settled at this meeting.

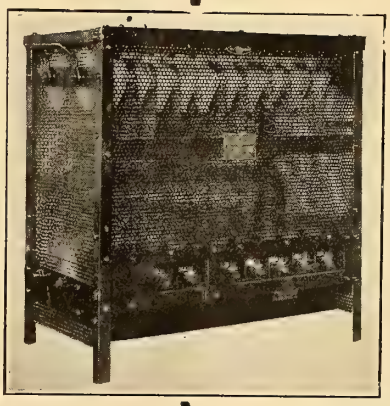
DR. SEASE (*Communicated*): In connection with that part of Mr. Manheimer's paper that seems to solicit some definite information regarding the explosiveness of gases given off by film, I consider that the vapors in a film vault of average size filled with film under average conditions will not be explosive or combustible. The vapor to be found is largely acetone. The acetone in the film may be as high as 2 per cent. It is usually much less. This acetone is very hard to remove and would require quite high temperatures to get it out of the film. According to our information, vapors of acetone are not explosive until the acetone content of the air is 3.7 lbs. per 1,000 cubic feet. We have no information on the accumulation of vapors in a vault which has remained closed a long time, but it is possible that the vapors may increase if the vault is practically hermetically sealed.

We know of no spontaneous combustion of vapors from film, nor have we had in our experience any fire caused by the ignition of vapors emanating from film. There are records of fires having been caused by static discharges over mixers into which solvents were being run.

While the vapor from film is largely acetone there is some alcohol, camphor, and fusel oil. These vapors have higher specific gravity than air, and, therefore, tend to settle.

It is possible that the vapor proof globe requirements have been established to reduce the hazard of igniting film by its contact with an incandescent lamp. Celluloid film ignites in a very short time at 300 deg. F. At 212 deg. F. it will not ignite for a considerable time. At 140 deg. F. we have observed its decomposition without ignition in five or six months.

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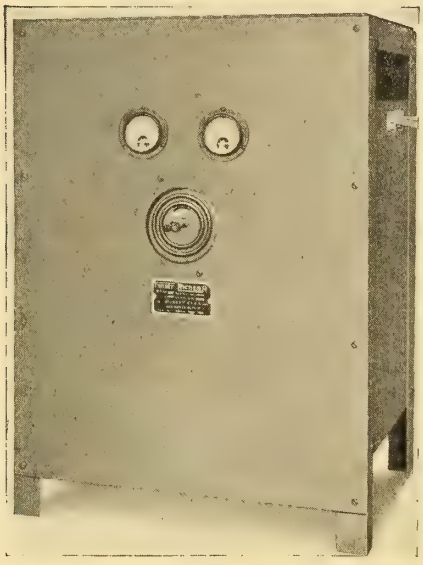
½" and ¾" Variation in E. F.

AS the name implies this new construction offers the projectionist everything he has been looking for; two focal lengths in one construction.

By rotating the ring on the lens mount the size of the image on the screen can be increased or decreased instantly to take care of the difference between sound and silent film. At the same time an automatic shifting of the center of picture on screen with sound film is provided for.

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Efficient Sound Reproduction

By R. H. McCULLOUGH

(*Continued from page* 18)

KNOWING the equipment, which you operate and work with is half the job. Operating sound reproducing and projection room equipment is a profession, which requires great skill. The service engineer's ideas are not always original but are rather an extensive series of experiments. The ability of projectionists and service engineers to thoroughly and quickly discover the troubles in an amplifier is largely a function of his ability to think logically and to approach the problem as one which may always be solved by a process of orderly elimination and orderly reasoning-out of cause from effect.

Every action, whether mechanical, electrical or chemical, which takes place in an amplifier, or its associated equipment is governed by known laws, and any variation from normal action can be determined by known methods. There is nothing mysterious about amplifier troubles except to the man who is not familiar with them. The value of an efficient, logical routine in testing amplifier equipment cannot be over-emphasized.

Shorted Condensers

The 42-A amplifier has been fully explained before as to its operation—however, many projectionists who encounter difficulty, particularly when one of the 21-CB condensers becomes shorted, are at a loss to know what the trouble is. A shorted condenser will cause the plate current meter to drop in value. A shorted 21-CB condenser will usually short-circuit the rectifier output and overload the 303-B transformer, which eventually burns out the secondary of this transformer. Crackling noises, heard in the output, can sometimes be traced to a leaky condenser. Usually a shorted condenser in the 21-CB bank can be detected by a burning odor.

If the shorted condenser is detected before the 303-B transformer is damaged, the condenser may be removed from the circuit until a replacement is made, which will not affect the operation. There are two banks of 21-CB filter condensers connected in the 42-A amplifier circuit. Each bank of condensers employs 4 one-microfarad condensers. If, by casual observance, you cannot detect the shorted condenser, cut out one bank of condensers and then try the amplifier.

If the trouble is still encountered try the other bank of condensers—if the amplifier functions, continue the performance with one bank of condensers and after the performance test each condenser in the bank which is shorted until you locate the one which is shorted.

Motor Generators

Many theatres have now installed motor generator sets, which have eliminated wet storage batteries. In case the motor generator should cease to function, there is no means of emergency for supplying current to certain vacuum tube filaments, exciting lamps, or the field circuit for receiver units. In every projection room, where a motor generator is employed to supply direct current to the projector arcs, an emergency supply can be obtained from this source, providing the voltage is reduced to that of the sound equipment generator.

This source of D. C. supply should pass though the filter system, the same as the D. C. supply which comes from the sound equipment generator.

Many projectionists do not keep exciting lamps clean. It should be remembered that a certain amount of volume is lost if the wall of the exciting lamp bulb is dirty in front of the filament just before the light flux enters the optical system of the sound reproducing mechanism. Discoloration of the walls of the exciting lamp bulb is an indication that it has

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passed the peak of its efficiency and that it should be replaced immediately with a new lamp.

Vacuum tubes are the most important and fragile of the things that comprise an amplifier. They are the most prolific source of trouble, and as progress is made by manufacturers in the elimination of other troubles, the ratio of the tube to other troubles increases. Next to tubes whose emission has fallen off, microphonic tubes give the most trouble in the photoelectric cell amplifier.

Care of Rheostats

There is a certain wear on rheostat parts. A rheostat consists of a resistance wire wound on a circular form of insulated material, one end of the winding being connected to one terminal, and the other terminal to a slider, which makes contact with the resistance wire, and can be rotated to obtain any resistance value desired within the range of the rheostat.

When one side of the rheostat element becomes worn, where the slider moves, it is well to remember that it can be reversed. There has always been a question as to the best lubrication for the moving parts on a variable rheostat. I find that if lubrication is required an ordinary lead pencil contains enough graphite, if rubbed lightly across the wire where the slider moves, will assist greatly in ease of operation and will also eliminate wear considerably.

Sound Efficiency is a department conducted solely for the benefit of projectionists. The editor invites contributions to the department of short articles on troubles and experiences with sound reproducing equipment. All articles submitted should be typewritten, if possible, and on one side of the paper. They should be accompanied by sketches, drawings or diagrams, and photographs are particularly desirable.

Proper Servicing Hints

H. M. Wilcox, Operating Manager of Electrical Research Products, Inc., was asked a series of questions relative to servicing of sound equipment. His replies to MOTION PICTURE PROJECTIONIST are given herewith.

"Answering briefly your questions I would say that sound reproducing equipment should be serviced regularly two or three times a month. The frequency of service depends largely on the care taken by the theatre operating staff in maintaining the equipment properly. One of the most important reasons for routine servicing is to prevent emergencies so that there is reasonable assurance that the "show will go on." At the persent time emergency calls of our service organization for the 4,700 equipments in operation in this country represent one call for about every 2,000 shows.

"The cost of repairs and replacements varies from about 50c per day to about $1.00 per day in accordance with the size of the equipment and the care exercised in operating and maintaining.

"To designate what parts of the apparatus seem to need most attention would be like designating the part of an aeroplane that needs the most attention. If something goes wrong in an aeroplane it drops and the aviator is killed. If something goes wrong with sound apparatus, the sound will stop and the show is killed. It is important that all parts receive attention, but the most important things are *cleanliness, proper lubrication and regular battery charging.*

"The largest items of replacement are vacuum tubes and photoelectric cells. These constitute from one-half to three-quarters of the total repair and replacement costs. There would be no advantage, from price standpoint, in buying these parts in bulk and there would be some disadvantage in that there is a very wide market for vacuum tubes and we know that exhibitors do have some loss due to stealage."

New G. E. Vacuum Tube

A new type of vacuum tube, so sensitive that it is capable of measuring one hundredth of a millionth of a billionth of an ampere of electric current, has been developed in the laboratory of the General Electric Company, according to an announcement by Ellis L. Manning of the company's research organization.

The flows of electrons in the tube, which is of the four-element type, Mr. Manning said, is so small that it compares with a fifty-watt lamp as two drops of water compare with that which flows over Niagara Falls in a year.

One of the major applications of the tube will be for the measurements of currents used to indicate the intensities of X-ray and ultra-violet beams. It will have other uses, too.

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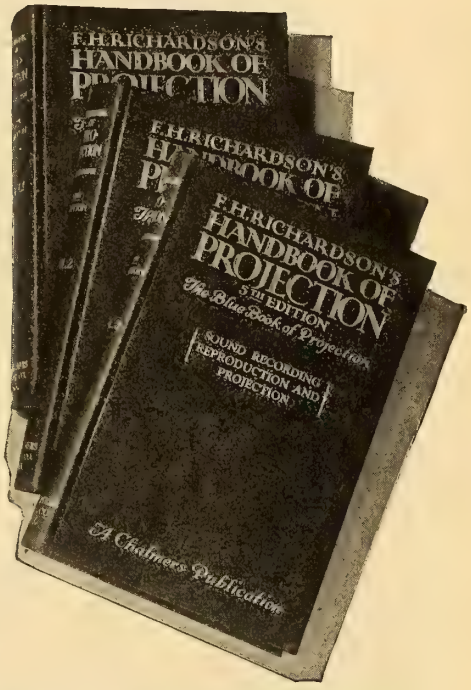
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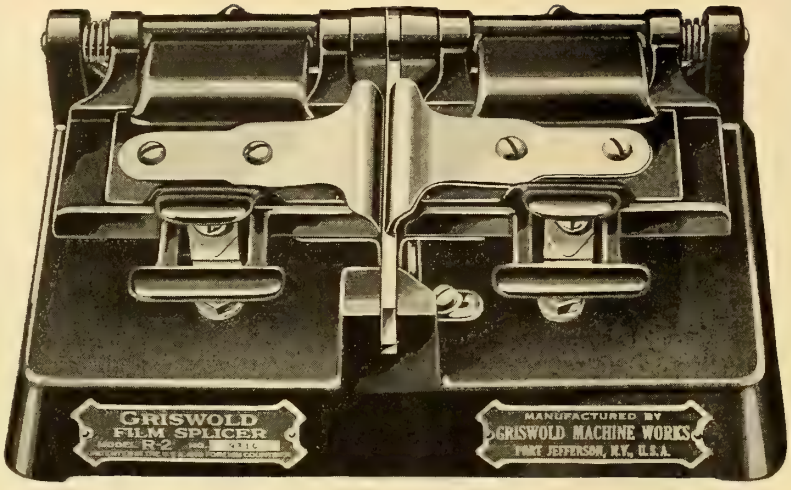
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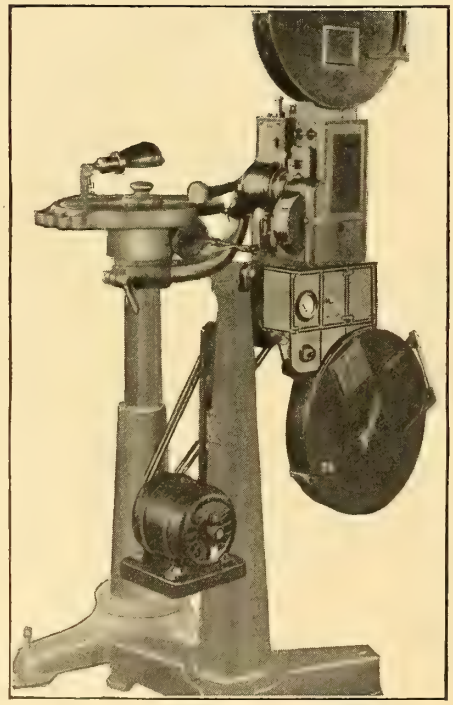
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Efficient Servicing Vital Sound Picture Element

By J. S. WARD

Electrical Research Products, Inc.

THERE has been considerable interest manifested since the introduction of the Western Electric System to the industry four years ago, in the service feature associated with that equipment. As since that time, many exhibitors have asked themselves the question, "Why service," it would appear to be a worth-while topic for consideration here.

First, a definition is in order. Service as furnished by Electrical Research Products, Inc., is the supervision of the maintenance and operation of these sound motion picture equipments wherever they may be installed, by a body of specialized engineers.

Since the modern sound system embraces apparatus and circuits requiring constant precision adjustment of a highly technical character, if satisfactory performance is to be assured continuously, ERPI service has been established on the theory that prevention practiced regularly outweighs in reliability and value returned any other form of corrective treatment.

Large Technical Staff

The big force of specialized technicians maintained to provide the service makes calls to each installation at frequent intervals. At first weekly calls are paid to newly installed equipments to insure that the theatre personnel becomes thoroughly acquainted with the sound system as rapidly as possible.

As occasionally some part may require replacement and in order that it may be furnished quickly if an emergency need exists, comprehensive stocks of parts have been located in many branch offices strategically situated throughout the country. Consumable material like vacuum tubes, photoelectric cells and exciting lamps for example are naturally required more often. Other items such as reproducers, receiver units, drives, motors, amplifiers, rectifiers and chargers also sometimes require attention.

Experience over a long period of time, indicates that these requirements vary considerably. Some installations seldom need replacements of any sort. A few have been known to have their vacuum tubes continue to function without interruption since the opening date.

Replacement Costs

A theatre in Charlotte, N. C., which was one of the first in the world to be equipped, reported very recently that it was still using the complete original set of vacuum tubes. In this connection, too, it is important to consider the matter of repair and replacement costs. The

expense to exhibitors expressed as a weekly average at present amounts to approximately $7.00 per installation based upon the total needs of all equipments in operation. This figure has been continuously declining. For the smaller type equipments, the costs of all replacement parts needed has, at the weekly rate, averaged still less, the figure being about fifty cents a day.

Emergencies whenever they occur and regardless of their nature, naturally receives the right of way. No matter whether resulting from fire, flood, accident or some more prosaic cause such as neglect to close a switch, once the call registers, all resources that may be required to assure speedy resumption of operation are brought to bear until the sound is restored. It is worthy of note that specially chartered airplanes have been utilized to this end many times when personnel or supplies were needed and other types of transportation could not meet the occasion adequately.

Establish Panama Local

Balboa, Canal Zone, is the most recent point at which the International Alliance has representation through the affiliation of a local union, proper installation of the local charter taking place on July 10th. It is interesting to note the conditions existent at Balboa that are in many ways at variation from those general in the United States proper. They are located in the heart of the tropics, and the architecture of their theatres is of a radical departure from that of the theatres in the States. Due to the warm climate three walls of all theatres are open to the air and screened in, which conditions bring up different acoustical problems. The atmosphere is extremely humid, causing difficulties by way of extreme corrosion to most all metals and mildew to lens cement, arc reflectors and disc records, all of which present problems peculiar to this locality.

The Panama Canal itself is one of the greatest show places of the world, it being one of the greatest engineering achievements of all times, and because of its location is patronized by tourists of all nationalities and from all parts of the world.

Electric Clocks

Telechron clocks, a product of General Electric, are now being distributed by National Theatre Supply Co. These clocks, which operate direct from electric circuits of the usual voltages, are operated by a small electric motor. They are said to require no winding, regulating, or cleaning.

Such a clock is a projection room necessity, in order that there may be no divergence from set schedule in picture presentation and to provide an accurate check on running time.



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Technical Improvements Aid Big Increase in RCA Photophone Installations

WITH 2,116 installations completed up to Wednesday, September 24th, and an average of 132 installations a month for the past nine months, RCA Photophone, Inc., has more than made good on the program of expansion that was announced last February, and at the present time is turning out and installing sound reproducing equipment to the full capacity of its factory, engineering and field forces.

"RCA Photophone, Inc., looks back upon the past nine months with considerable pride," said Sydney E. Abel, general sales manager, in discussing past accomplishments and future plans. "On February 15th last, announcement of a definite policy was made. That we have lived up to the provisions of that policy, is obvious. On January 1, 1930, we had installed 926 equipments. Today (Sept. 24th), our books show 2,116. We believe we are justified in reaching the conclusion that the reason for this remarkable progress in the field of sound reproducing equipment for motion picture theatre is that RCA Photophone apparatus is delivering 'sound satisfaction' to patrons of theatres and to the exhibitors in whose theatres the equipment has been installed.

Quality Reproduction Demanded.

"Quality sound reproduction is demanded by the patron of the motion picture theatre today. The experiences of the past few months, during which time RCA Photophone installations have far exceeded our expectations, have been most enlightening. The exhibitor seems to have but one thought in mind. Having come to the full realization of the fact that the public, upon whom he depends for support will no longer tolerate inferior sound, he is now bending every effort to secure only the best type of sound reproducing equipment. He knows that the large producing corporations have attained a high point of efficiency in recording and that, in order to give his patrons full value for their support, he must present the product of the studios in a thoroughly satisfactory manner. He has become convinced that if he does not completely satisfy his patrons they will transfer their patronage to some other theatre.

"In the effort to aid the exhibitor, RCA Photophone renders every possible assistance during negotiations for installation and offers complete service thereafter. House conditions, particularly with regard to acoustics, are carefully investigated by experts and the best advice follows. Given such acoustical treatment as may be required, RCA Photophone sound reproducing equipment will function to the highest efficiency. We know our equipment will deliver superior sound if house conditions are such as to make it possible."

Many RCA Refinements

Although RCA Photophone equipment has been delivering satisfactory sound to theatre audiences, the corporation's engineering department has succeeded in perfecting refinements in two distinct parts of the reproducing mechanism that have enhanced the functioning of the equipment as a whole to an almost unbelievable degree, according to Mr. Abel. For several months the engineers have been endeavoring to increase the sound frequency range of the directional baffle and loud speaker and it is said that they have succeeded in producing a speaker that delivers clear, rich and mellow sound from the extremely low frequency range of 50 cycles to the heretofore uncaptured high frequency range above 7,000 cycles. Even the indistinct "s," "f," and "th" sounds are clearly distinguished by this ingenious device.

Another improvement has been made by the addition of an impedance roller in the sound head. This roller has a flywheel effect which gives the film an absolutely steady and uniform motion as it passes through the sound gate, thus eliminating the flutter that heretofore has produced distorted sound. Both of these improvements are now being included in the latest types of RCA Photophone reproducing equipment and may be added to types already in use.

Basis of 8x5 Rectangle

The proportions of the rectangle have been a subject of scientific study since about 1875. At that time it was noted that man, in using the rectangle in nearly all of his buildings, furniture, and conveniences, adopted a ratio which was strikingly different from the perfect square. This ratio tends to be about five to eight, a combination which has been called the golden cut, frequently found in crosses, windows, *et cetera*. The formula has been: the short side is to the long side as the long one is to the sum of the two. This must not be regarded as a law to be striven for or which will bring punishment if it is transgressed. The eyes have one pair of muscles for moving them in the horizontal but two pairs for moving them in the vertical. Vertical movements are harder to make over a wide visual angle. As man has lived in his natural environment he has usually been forced to perceive more objects arranged in the horizontal than in the vertical.

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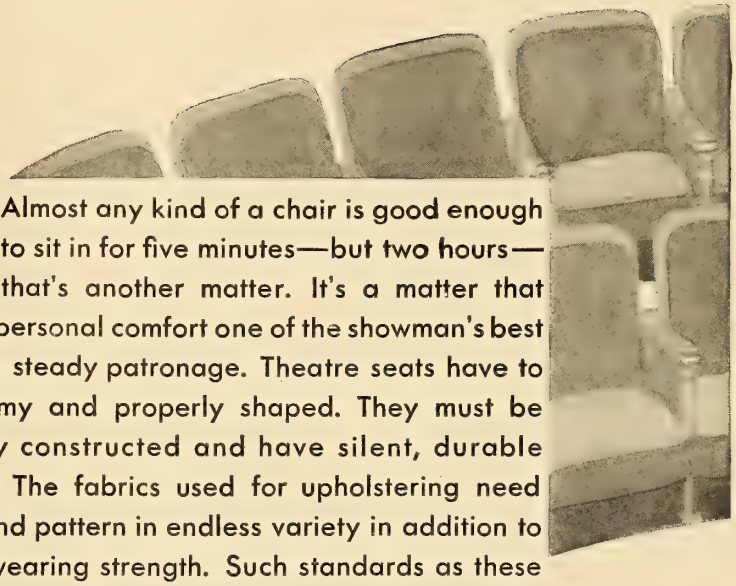
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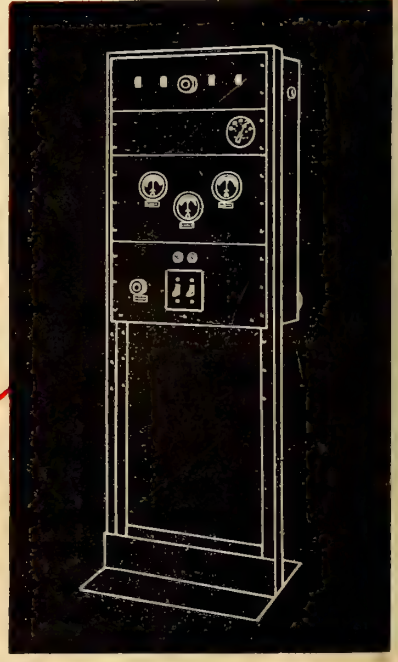
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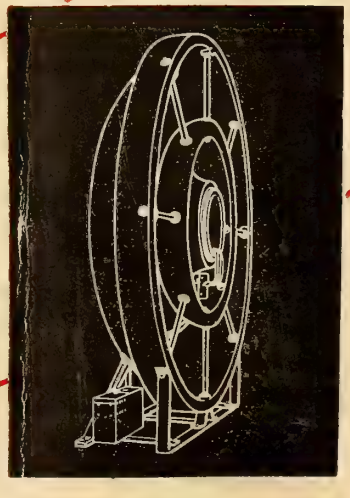
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